Iron and Steel ENGINEER

ENGINEERING SERVICE
TO THE IRON AND STEEL
INDUSTRY SINCE 1907

JUNE, 1958

TECHNOLOGY DEPT.

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DETROIT

CLEANING AND ANNEALING LINES

MESTA 2000 FPM Continuous Cleaning and Annealing Line for Steel Strip in Tin Plate Gauges with Pay-Off Reels, Mash Welder and Tension Reels in Operation at Weirton Steel Company, Division of National Steel Corporation.

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

For Your A-c Mill Auxiliaries Save with Cutler-Hammer Unitrol

Standardized Modular Construction

All control units are 20" wide and in multiples of 14" in height. This permits easy interchange of various sizes and types of control units without rearrangement of the entire control assembly and avoids wasting space with dead panels to adapt non-uniform control units. This standardized modular construction also insures good appearance at all times because horizontal lines match.

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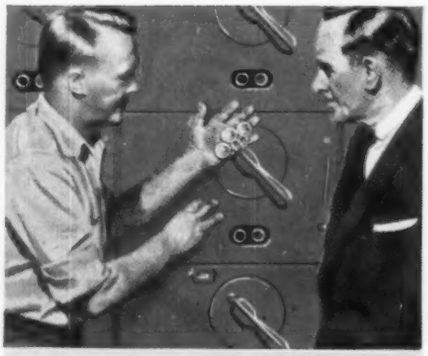
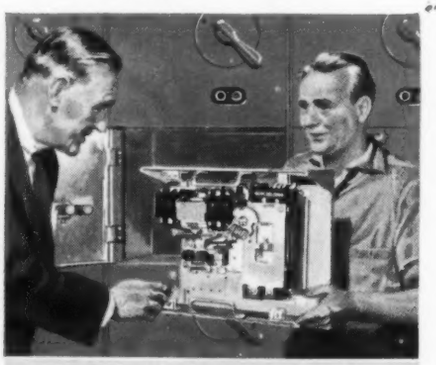
CUTLER-HAMMER
UNITROL
C-H

Unitrol plug-in feature disconnects control from power when unit is moved to test position, reconnects without misalignment when unit returns to operating position. Control panel is *always* vertical. Plug-in design permits back-to-back assemblies without staggering control units. Units are removed by merely disconnecting load and control wiring at terminal boards. This wiring is cabled, marked and color coded.



Unitrol provides either circuit breakers or fused disconnect switches of advanced design. Both have three-position self-aligning operators arranged for padlocking with as many as three locks in the "off" position. Recessed pushbuttons and concealed door hinges are typical features that add to safety and fine appearance.

The name UNITROL is a Cutler-Hammer trade mark



Components front of panel mounted without stacking. No crowding, no power connections near panel fasteners. Many Three-Star Control exclusives. Superlife vertical contacts *never* require maintenance expense in all normal control uses. Adjustable overload relay coils let motors work harder with safety. Full Three-Phase Protection with 3-Coil overload relays on standard size starter panels.

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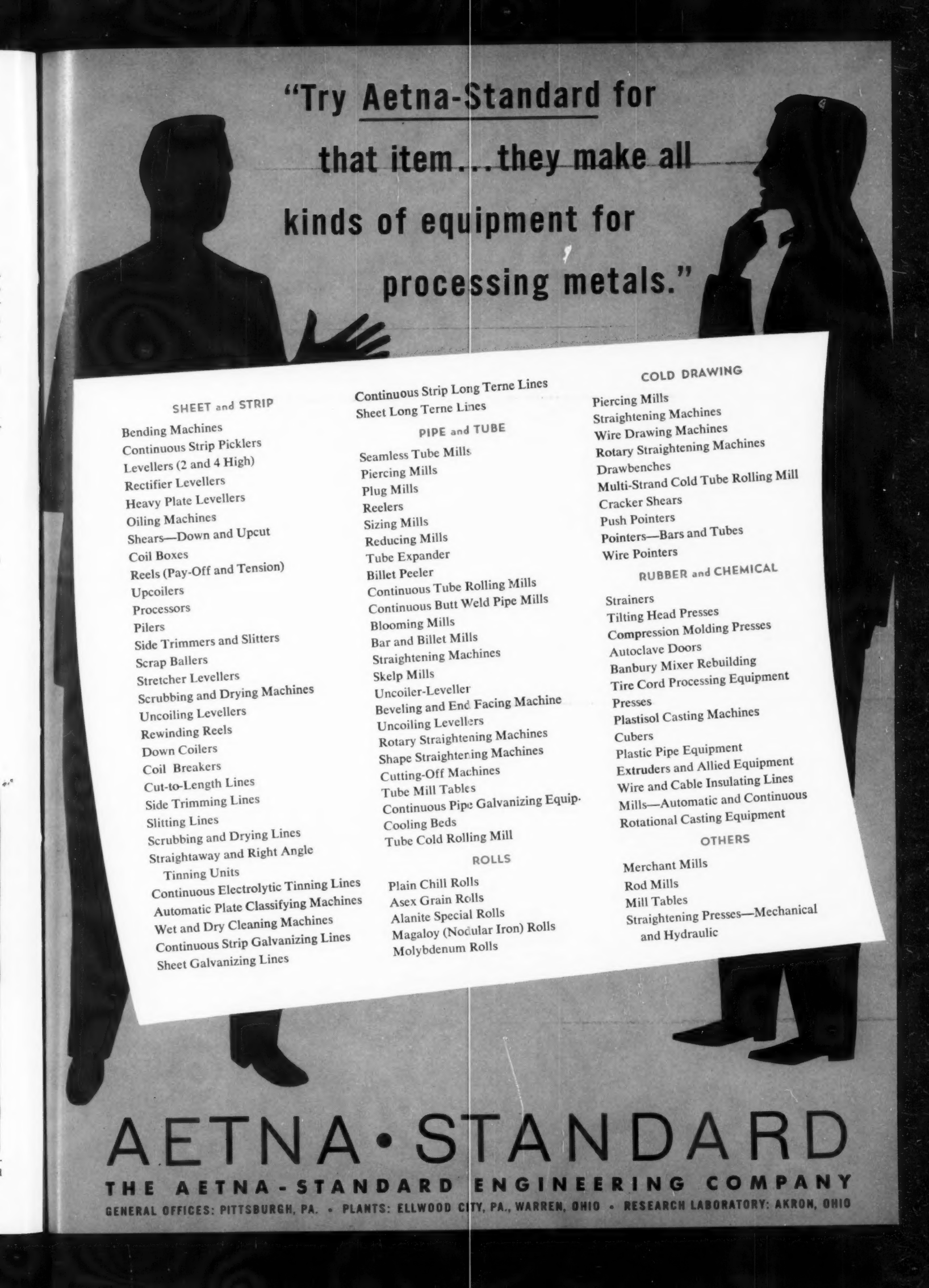

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Bending Machines
Continuous Strip Picklers
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Rectifier Levellers
Heavy Plate Levellers
Oiling Machines
Shears—Down and Upcut
Coil Boxes
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Scrubbing and Drying Machines
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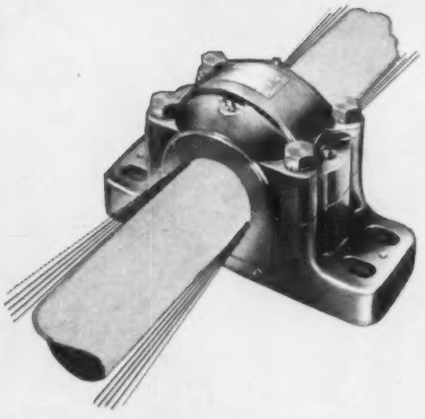

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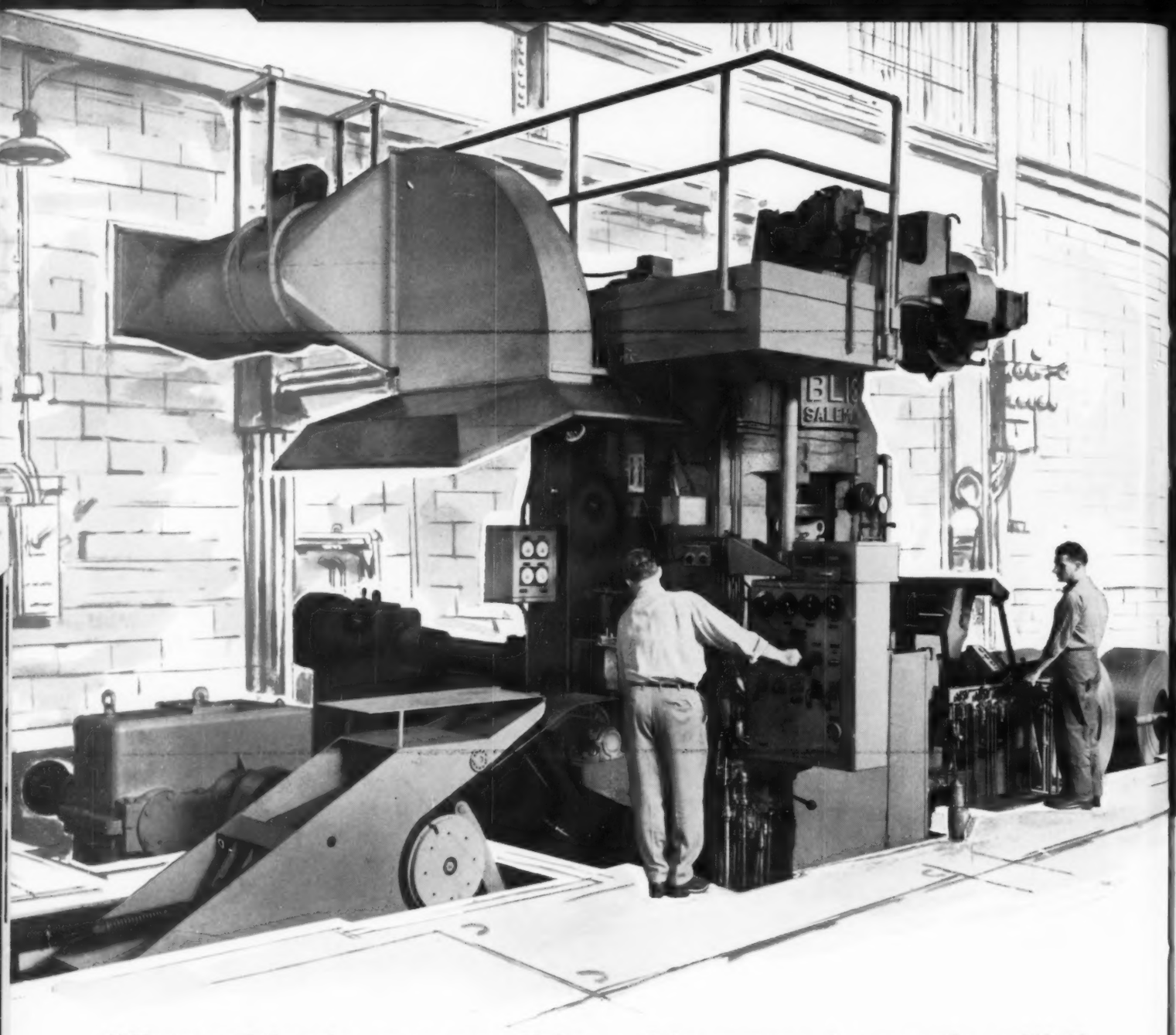

"Everything's accessible... it's easy to work with" says Thompson Wire of its new one way cold mill

The operating men at Thompson Wire's Sparrows Point plant especially appreciate the accessibility of controls on their Bliss one way cold mill. That's easy to understand when you realize that they use the mill to convert a wide variety of material ranging from ordinary carbon steels to "aircraft quality" and special saw blade steels.

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Because, among other reasons, the average number of passes were low in Thompson's case, the one way mill proved a more economical choice than a reversing mill. In other cases, the opposite has been true. For examples of both, and of other Bliss equipment, write for our new 84-page brochure.

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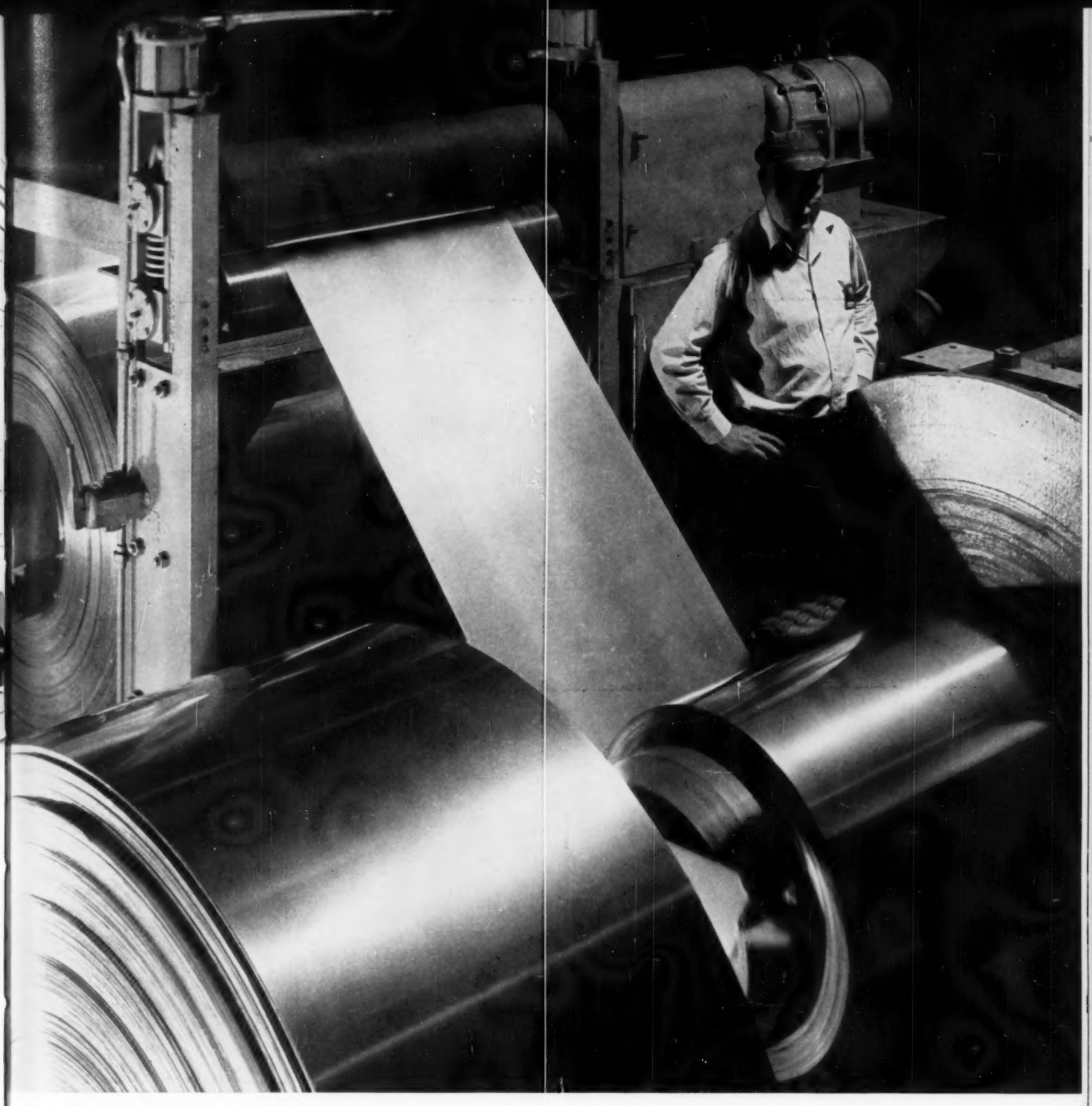

Photo courtesy Wheeling Steel Corporation

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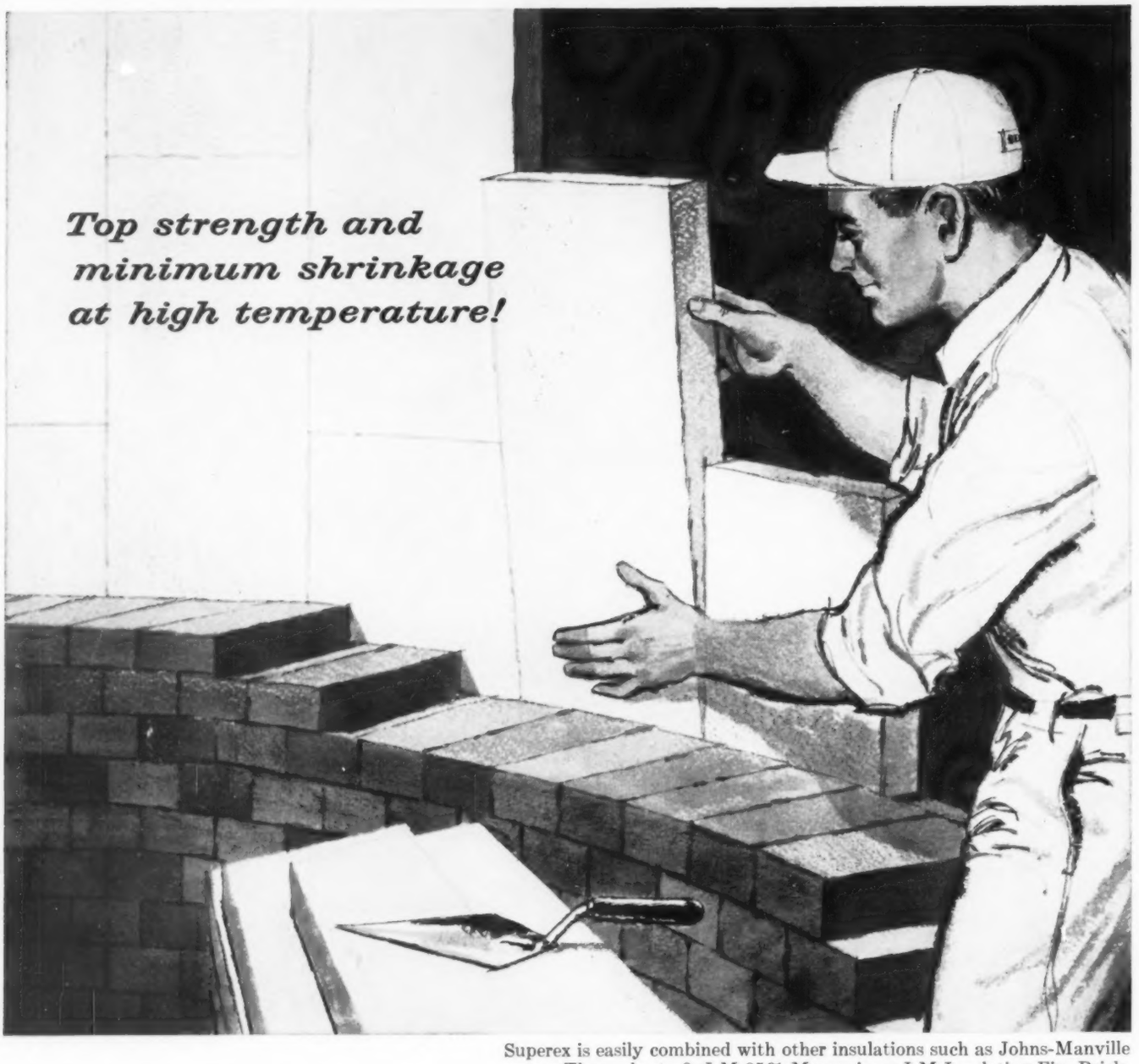

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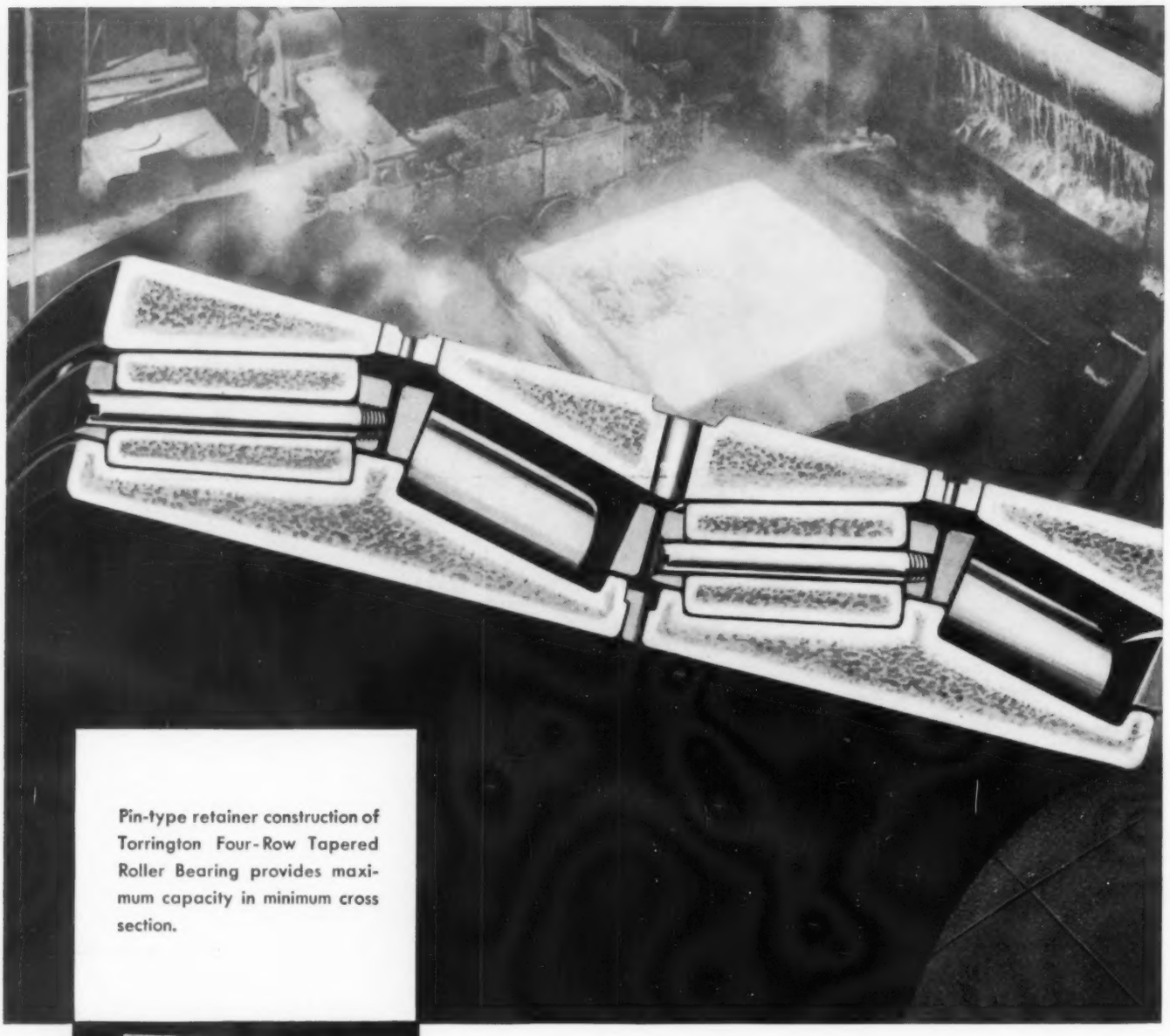
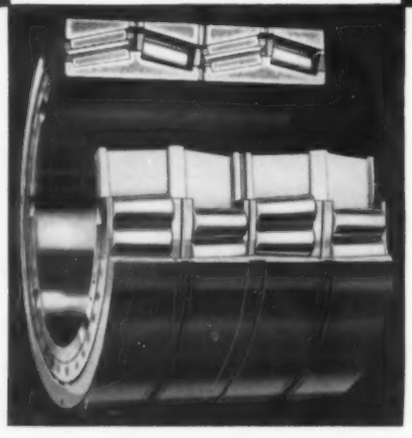


Pin-type retainer construction of Torrington Four-Row Tapered Roller Bearing provides maximum capacity in minimum cross section.



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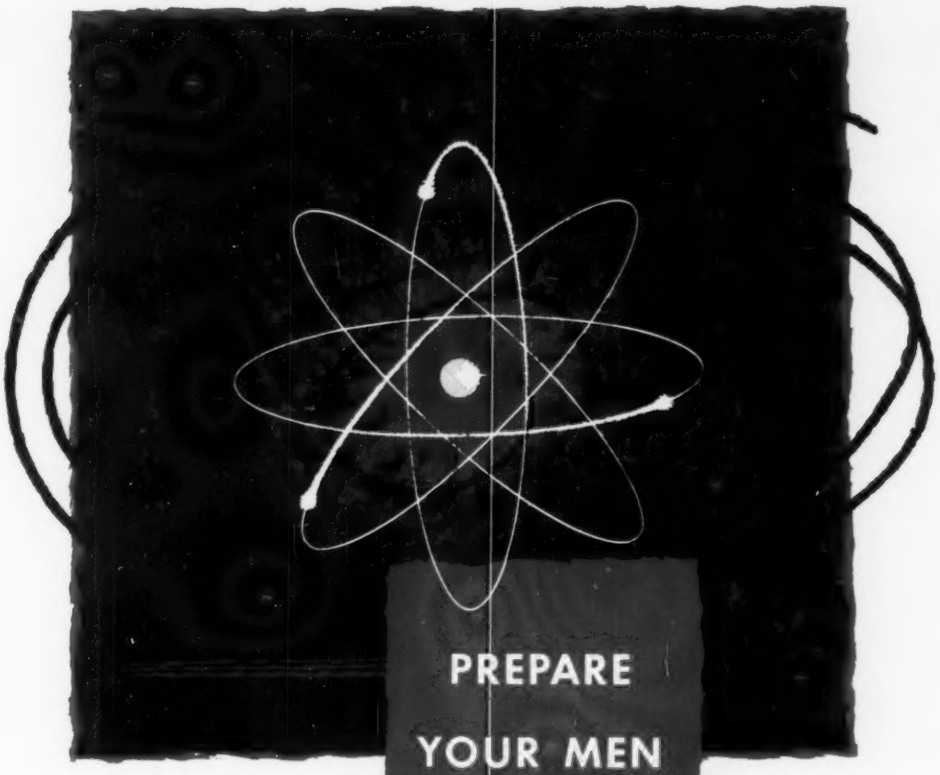

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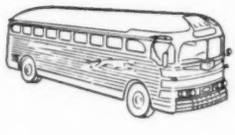

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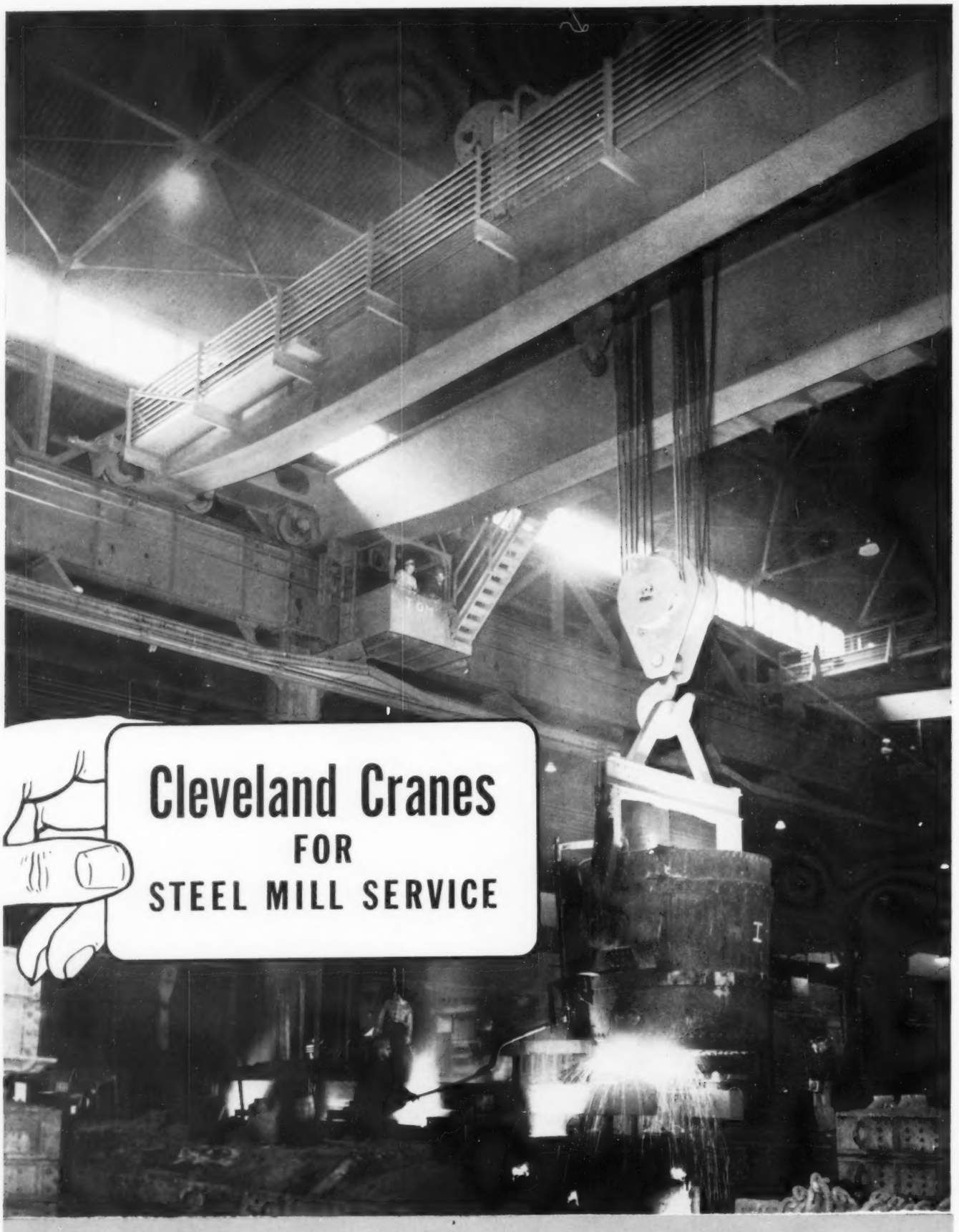

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MODERN ALL-WELDED STEEL MILL CRANES

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Crops *and* Shorts

Δ Steel plant machinery makers have not felt the recession to the extent that other machinery makers have, but their orders have declined and back-logs are decreasing. The Value Line Investment Survey, however, points out that there is a built-in stabilizer in the machinery industry. Spending must be held at the present level merely to replenish the capital investment that is being consumed. When the economy resumes its upward trend, a much higher rate of capital spending will be needed.

The Survey, which now predicts U. S. steel production in 1958 at 85,000,000 tons, also points out that the growth of the Canadian steel industry has outpaced that of the U. S. for many years. Between 1939 and 1956, Canada's steel capacity was enlarged 150 per cent. Since the end of World War II the industry has been virtually transformed, with modern, efficient equipment replacing old machinery.

Δ Much of the growth of the Canadian industry is explained by an address by D. S. Holbrook, president of Algoma Steel Corp., Ltd., before the American Iron and Steel Institute. Mr. Holbrook pointed out that since 1949 the Canadian government has used a depreciation system whereby heavy machinery and equipment are depreciated at a rate of 20 per cent write-off of the reducing balance. This makes possible the recovery, for tax purposes, of more than two-thirds of the cost of the facilities in five years. Also, a full year's depreciation allowance is granted on acquisitions made at any time during the year.

The climate created by this depreciation is indeed conducive to modernization. Washington might take a lesson from Canada.

Δ Jones & Laughlin Steel Corp. is now turning out 81-ton heats from its oxygen-blown converters at Aliquippa. This is said to be a record.

Δ Explaining the recent merger of Armco Steel Corp. and National Supply Co., R. L. Gray, president of Armco, spoke of the possibility of adding 1,000,000 tons of annual steel capacity at the Houston plant of Sheffield division and the installation of a pipe mill there. He also mentioned that Armco was considering the addition of coke ovens and a blast furnace at its Butler plant.

Δ The National Parking Association recently reported that, in the last ten years, bigger cars have cut parking lot capacities by 15 per cent and the capacities of older garages by as much as 40 per cent. The average of the eight biggest-selling U. S.-made cars has grown 18.2 in. in length and 6.8 in. in width over the past 20 years. The situation has led many public officials to advocate a vehicle tax based on car length.

Instead of two cars in every garage, what we need these days is two garages for every car.

Δ Incidentally, Sumner Slichter, Harvard professor of economy, testified to a U. S. Senate committee that "an important factor in the recession is the weird collection of headlights, fins, tails, wings, etc., that is called an automobile in '58."

Δ According to the American Iron and Steel Institute, the average wage rate in the industry has reached a new peak at slightly over $3.09, plus more than 30 cents for pensions, social security, insurance and unemployment benefits. This is about 26 cents higher than a year ago.

It's a funny kind of a recession.

Δ An observant youngster described Father's Day as "just like Mother's Day, only you don't spend so much."

Δ United States Steel Corp. is entering the aluminum-coated sheet steel market. The product will be made on a modified 48-in. light gage continuous hot-dip galvanizing line at Irvin Works.

Δ In the school year 1956–57, U. S. colleges and universities granted 31,211 bachelor degrees, 5233 master degrees and 596 doctorate in engineering.

Δ Dave Garroway, on his TV program says: "The highest literary award in our country carries with it the sum of $1000, at a time when television quiz show champions go home with a hundred-fold more. This, I believe, is a matter of national shame."

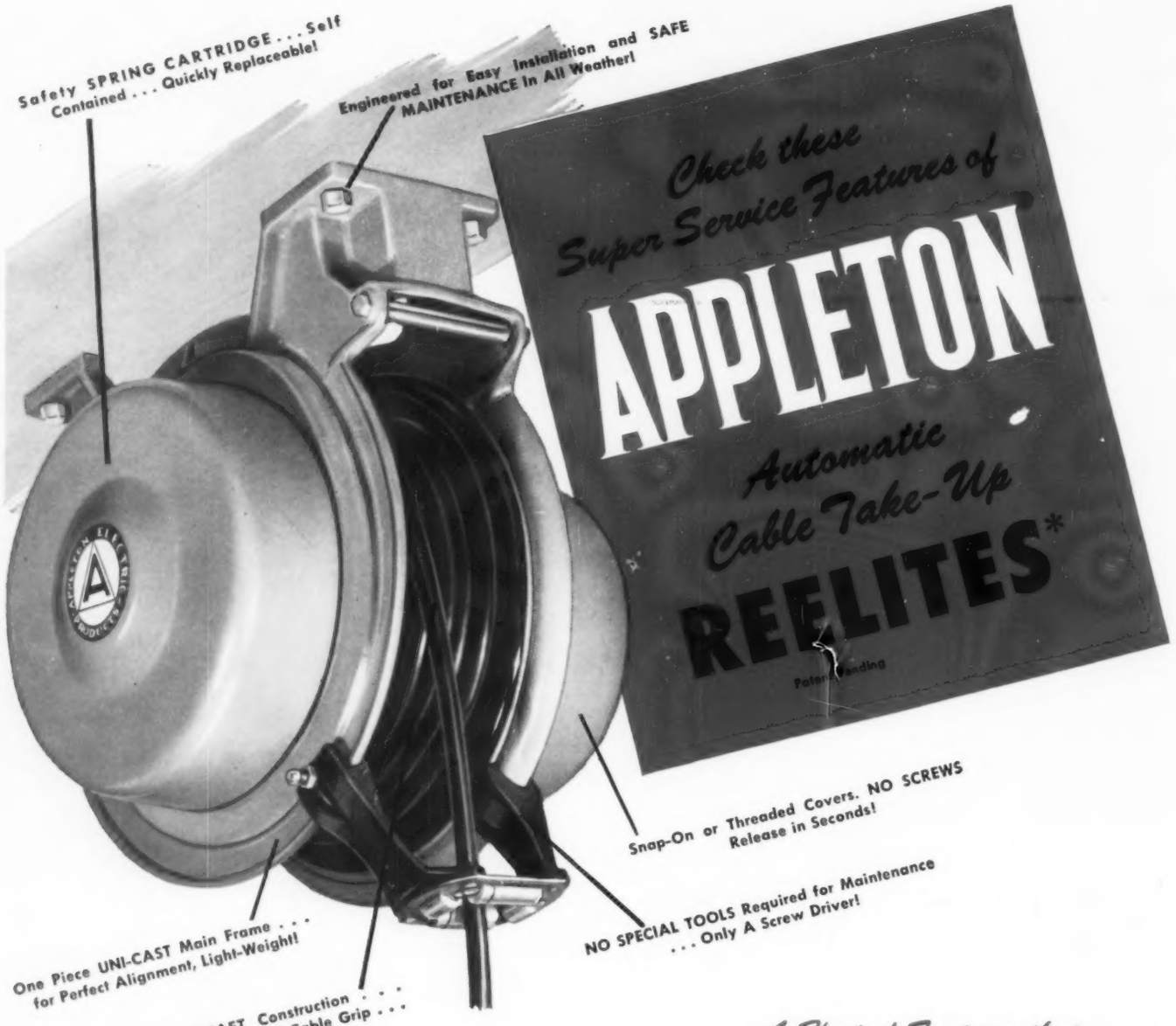
Δ Results of a survey made by the American Management Association, with 688 companies answering, show that 54.3 per cent of the companies plan to spend as much or more for capital expansion in 1958 as they did in 1957; 80.5 per cent will spend as much or more for advertising and promotion; 93.4 per cent will spend as much or more for research and development; and 95.8 per cent will spend as much or more for direct sales effort.

Δ Union dues of American workers have been estimated to average $2.81 per month and to total $700,000,000 per year.

Δ University of Pittsburgh has established a new graduate course in air pollution. It will emphasize methods of appraisal and engineering control of air pollution.

Δ The recent Economic Mobilization Conferences staged by the American Management Association brought out top brass of American industry, used Vice-President Nixon as a panel moderator and President Eisenhower as after-dinner speaker.

Among anti-recession steps mentioned by the industry men were stepped-up research, development, promotion and sales. Capital expenditures to modernize plants and reduce costs were deemed important. New, useful products at attractive prices are necessary. Tax reform, a monetary policy to encourage investment and construction, and a national labor policy that recognizes the realities of monopoly union power were also recommended.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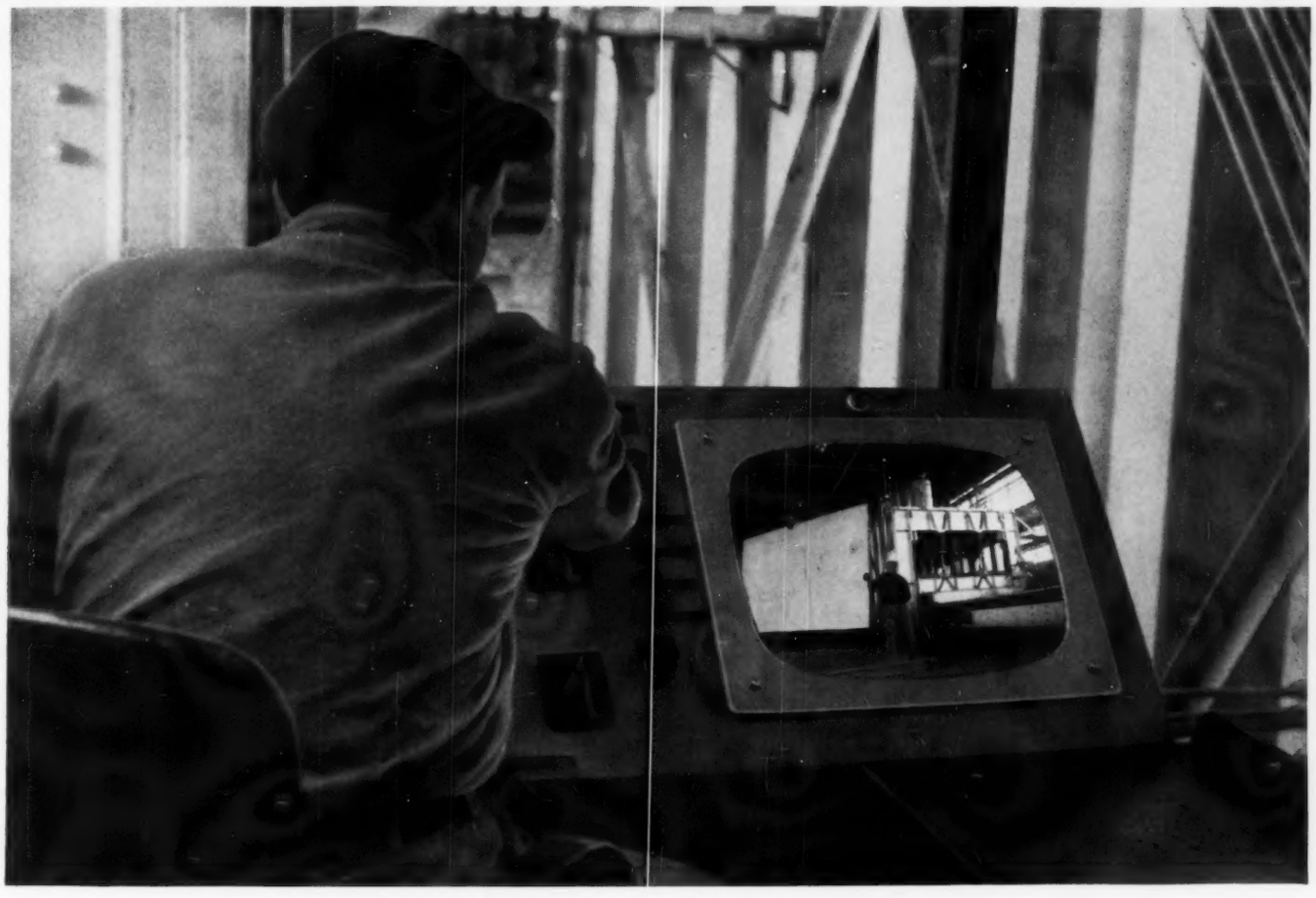

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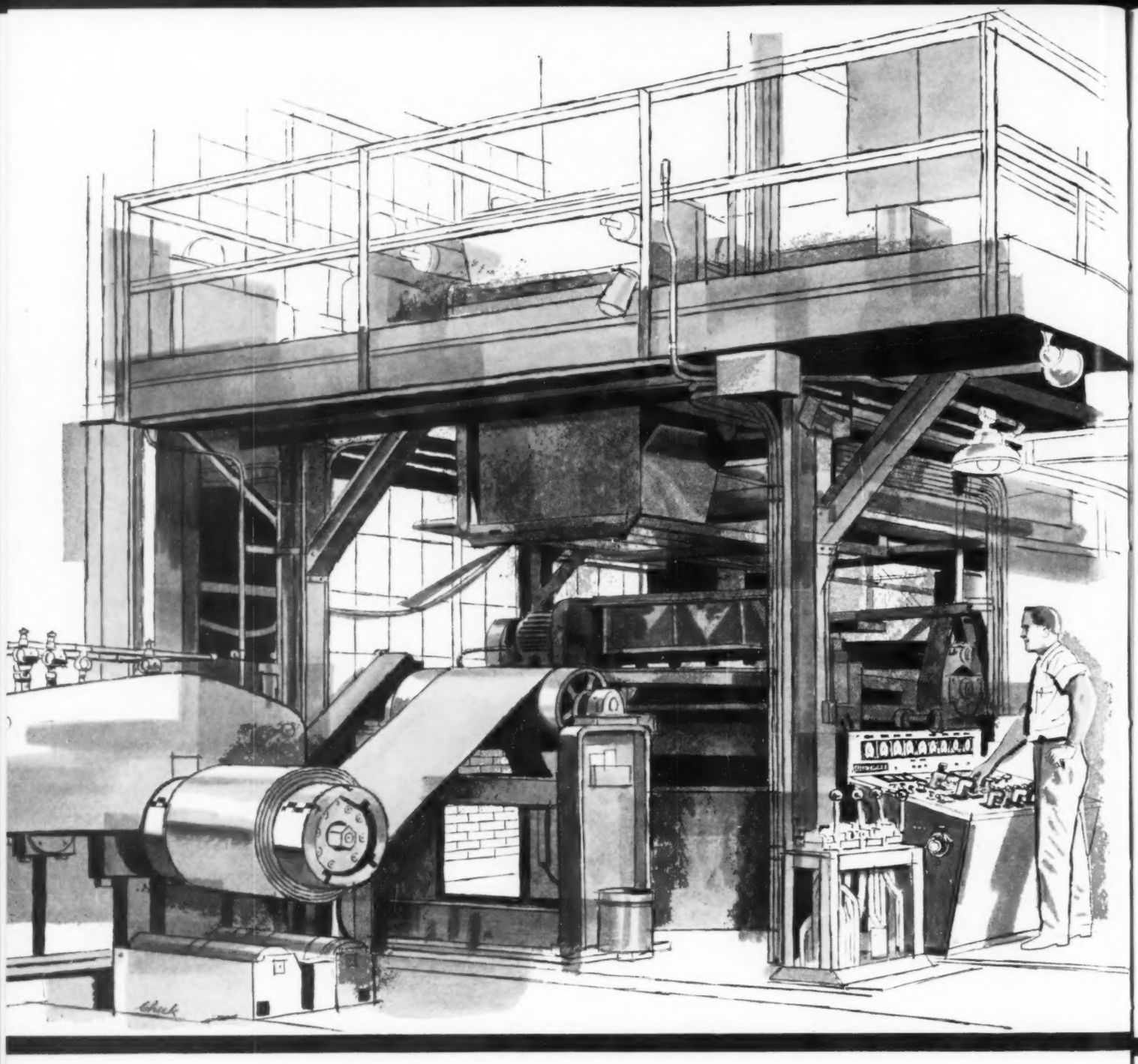

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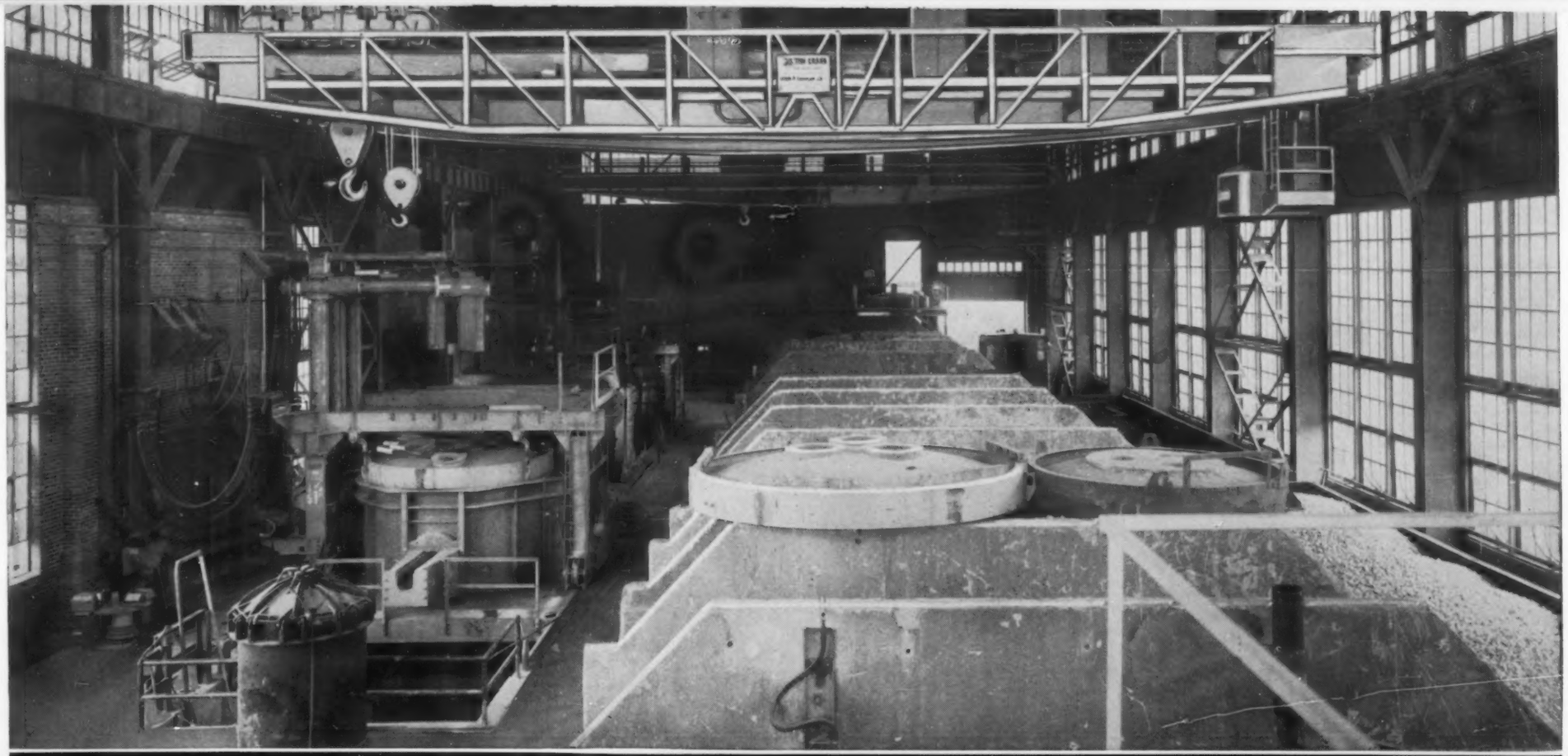

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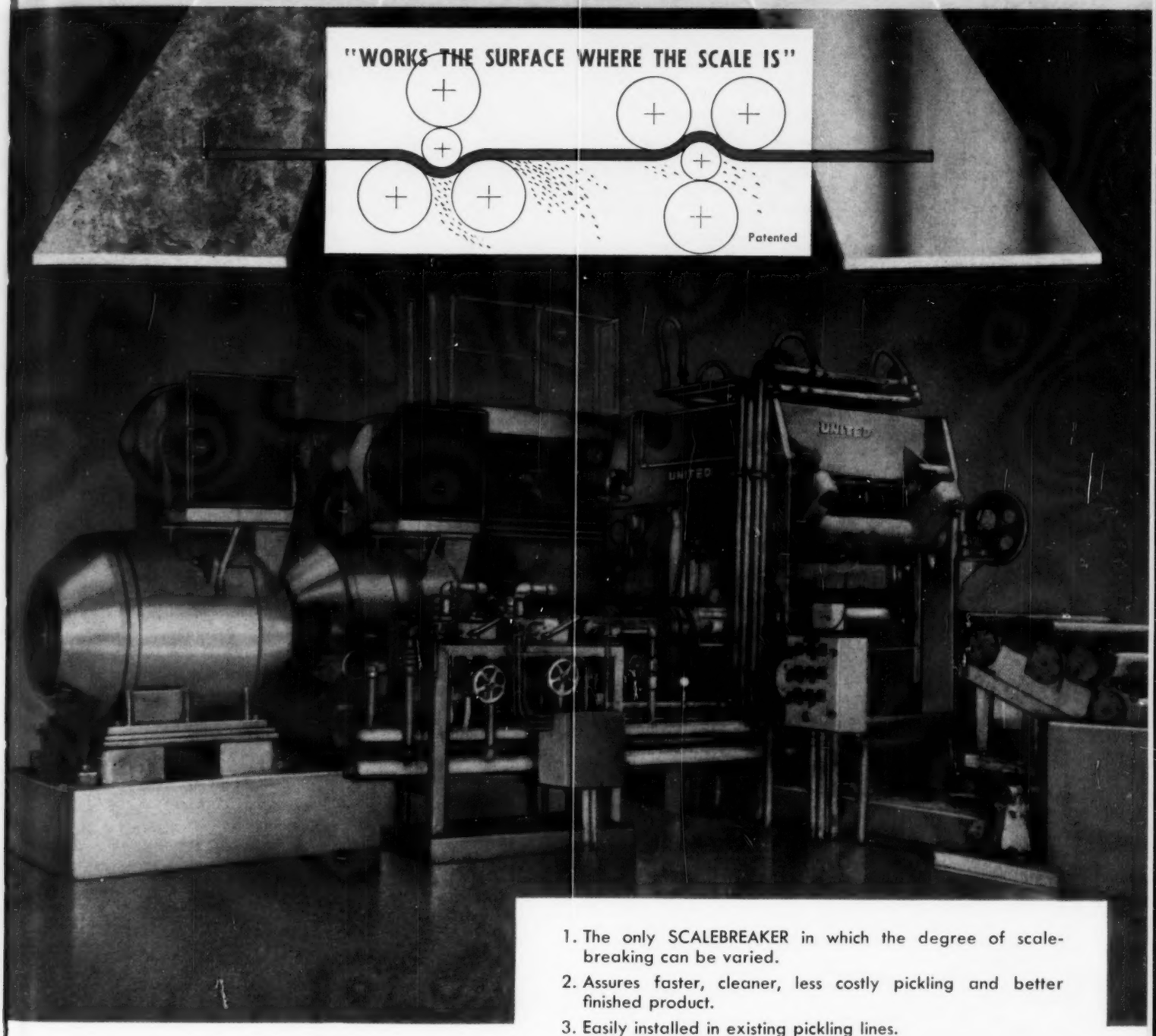

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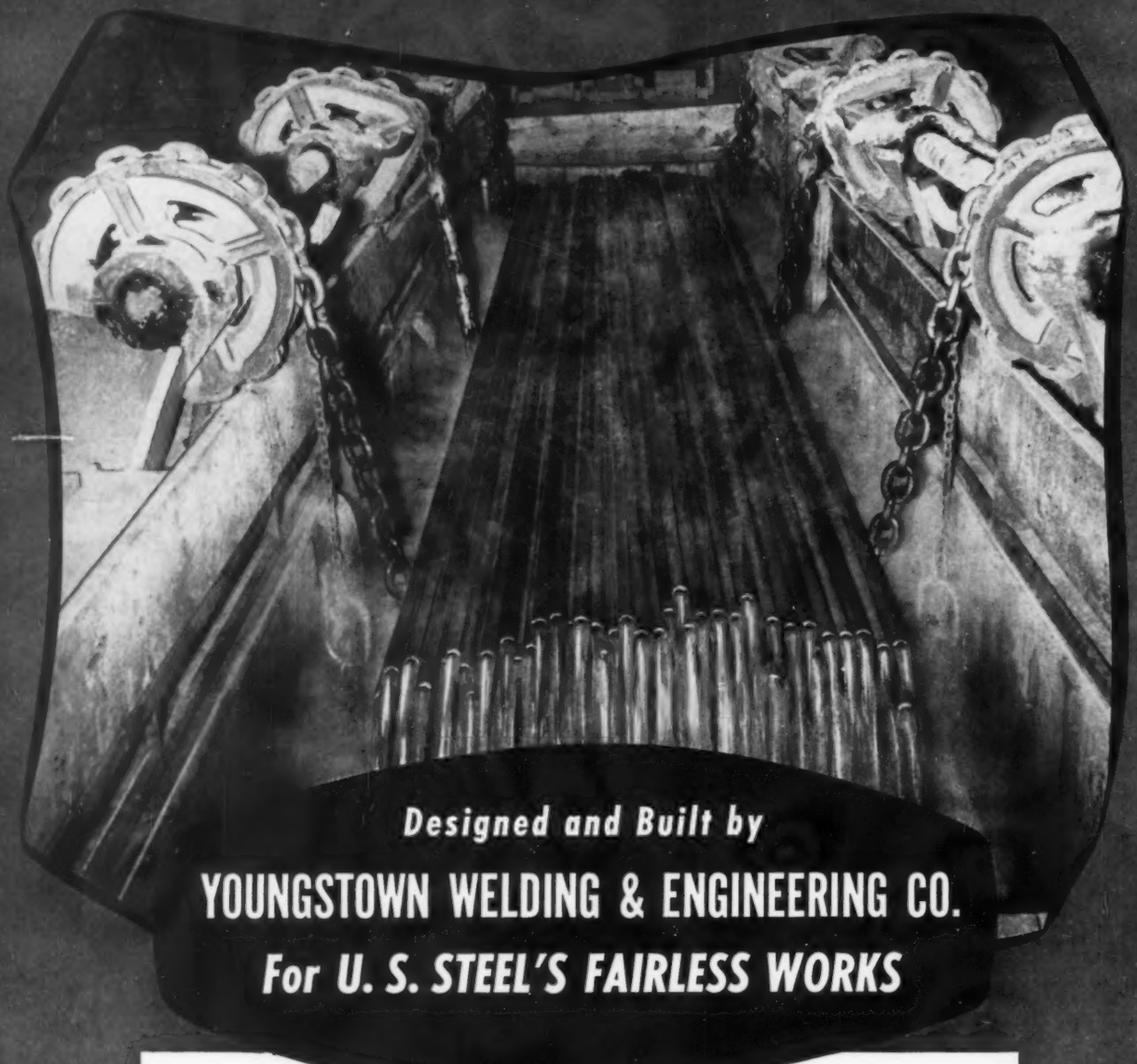

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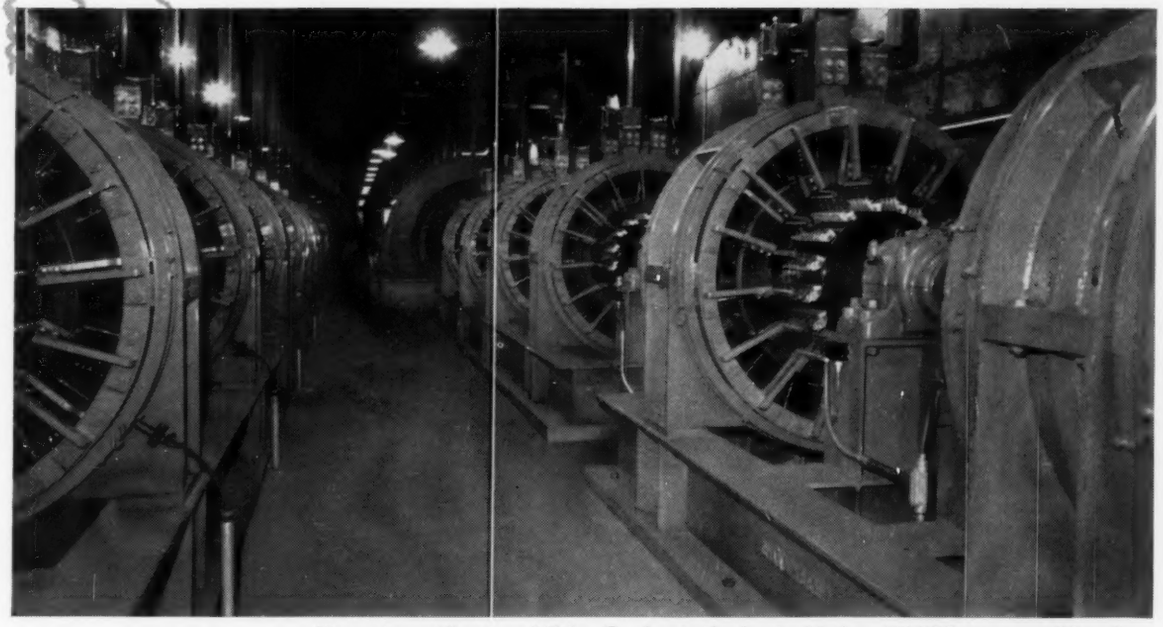

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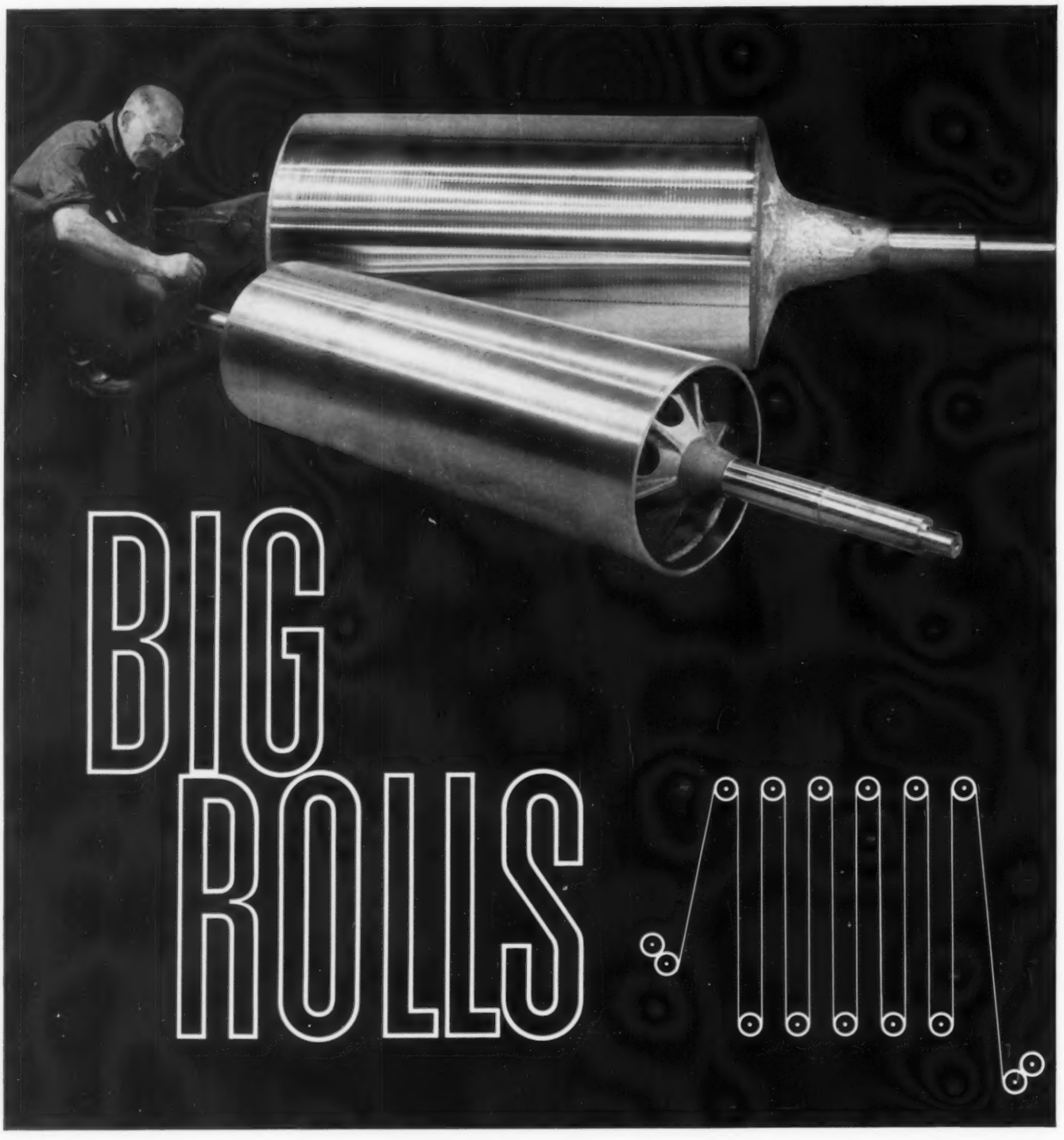

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patent reviews

By MELVIN NORD, Patent Attorney, Detroit, Mich.

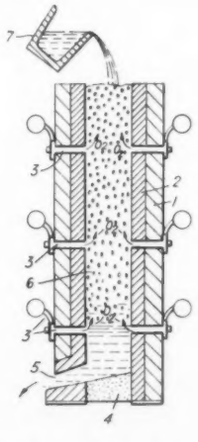
Copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents . . . . . patents reviewed cover period January 7, 1958 through February 4, 1958

PROCESS FOR REDUCING THE METALLOID CONTENT OF IRON

△ U. S. 2,819,160, issued Jan. 7, 1958 to Leonard C. Bannister, William J. B. Chater, and James A. Charles, assigned to The British Oxygen Co. Ltd., describes a process for removing metalloids such as sulphur, phosphorus, manganese and silicon from molten iron as a step in the formation of steel.

As shown in Figure 1, the process consists of passing the molten iron downwardly through a packed tower, preheated to a temperature such that the molten metal does not freeze during its passage through the tower, in countercurrent flow to a stream of oxygen so that an oxidizing zone is produced at the bottom of the tower and a reducing zone at the top of the tower. The packing material may be a material which will assist in the metalloid removal, for example, limestone or lime, or a mixture of limestone or lime and coke or lime-coated coke. Alternatively, it may consist of inert refractory material. If desired, one or more fluxing agents may be included in the packing materials. Examples, of such fluxing materials are soda ash, iron ore, millscale, iron oxide and fluorspar, and mixtures of these. In addition, the packing material may also include slag, which may be slag tapped from the tower itself or produced in a separate steelmaking process or made specially to the required composition.

Figure 1



As the reactions of oxidation of carbon and that of slag formation proceed, the character of the gaseous mixture changes from that of being oxidizing to that of reducing. As a result, the upper zone of the furnace below the liquid iron feed is maintained predominantly in the reducing condition. Such a distribution of the two zones, the oxidizing zone at the bottom of the furnace, followed up by the reducing zone, can be produced by careful control of the rate and composition of the bottom gas stream on one hand, and the rate of charging of molten iron, coke, slag forming substances, and fluxing agents on the other.

The tower 1 is made of insulating brick and is provided with a lining 2 of a refractory material, such as dolomite, silica, chromite, magnesite, alumina or sillimanite. Tuyeres 3 for the introduction of the oxygen or oxygen-containing gas are provided at three levels up the tower and, if desired, may be provided with appropriate cooling means. At the bottom of the tower is located a renewable hearth 4 sloping to an exit 5 for the treated metal and slag. The tower 1 is filled with a bed 6 of packing material.

METHOD OF RECLAIMING SCRAP STEEL

△ U. S. 2,819,159, issued Jan. 7, 1958 to Robert E. Treybal, William H. Kapfer, and Laimonis Bajars, assigned to Scrap Conservation Committee of the Steel Industry, describes a method of removing tin from ferrous sheets which are to be reclaimed as scrap.

The tin-coated ferrous material to be treated is placed in an open-hearth type furnace and heated to its melting point. The furnace in which the detinning is done must not be lined with a material such as calcium oxide, which would preferentially remove the sulphur, and prevent the formulation of tin sulphide. The steel scrap may contain such foreign matter as foodstuffs, paper, glue, enamel, etc., which are completely destroyed by the high temperature of the molten mass. To the molten ferrous material is added a sulphide of iron in an amount 50 to 200 per cent or more in excess of the quantity required to convert the tin present in the molten mass to tin sulphide. A gas which is not particularly reactive with the steel, such as air, nitrogen, etc., is then blown through or passed over the molten mixture to increase the rate of volatilization of the tin sulphide which has been formed. It is not necessary that such gas be under pressure. Adding a small amount of lime to the molten mass causes it to form a readily

removable slag with any residual sulphur remaining therein. The resultant molten mass is essentially pure steel containing from 0.1 to 0.05 per cent, and even as low as 0.01 per cent, of tin by weight and which may be added directly into a steelmaking process for the production of new steel. It has been noted that carbon must be present in the steel scrap if detinning is to occur by this process. Detinning in the complete absence of carbon does not produce satisfactory results.

METHOD OF PRODUCING RIMMED AND CAPPED STEEL

△ U. S. 2,819,503, issued Jan. 14, 1958 to Vincent C. Boucek, assigned to United States Steel Corp., provides an improved method of treating rimming steel in the ingot mold so as to control more accurately the case thickness and to reduce the degree of center segregation in the top, thereby reducing the proportion of the ingot which must be diverted to common products.

A heat of rimming steel is partially deoxidized in the ladle by the addition of ferromanganese, ferro-titanium, silico-manganese, or aluminum. The molten metal is then teemed into ingot molds as usual with the addition of known rimming agents and additional deoxidizers. Rimming is allowed to proceed unrestrained for a predetermined period only, e.g., 1 to 2 minutes. This causes the formation of a case of solid metal of controlled thickness surrounding the still molten upper central portion or core. A quantity of deoxidizer is then added, in an amount sufficient to arrest rimming and cause gradual but incomplete deoxidation without causing a crust to form on top of the metal or preventing further rise of the metal in the top of the mold. By such addition, the strong rimming action is reduced to a slow gentle movement on the surface of the metal.

When the ingot has solidified sufficiently, the cap is removed from the mold, the mold is stripped from the ingot and the ingot is subjected to soaking and working in the usual manner.

The chief advantage is the fact that a large portion of oxygen in solution in the liquid core of the ingot is fixed as a solid oxide most of which is fluxed off into the scum at the top of the ingot during the final gradual deoxidation. Comparatively few blowholes remain under the skin of the ingot, and the ingots can therefore be heated faster with the danger of burning the steel greatly reduced. Further, since there is much less gas pressure under the skin, it is not ruptured in rolling, even though the skin may be very thin, and the billet surface obtained is much more nearly free of seams and slivers.

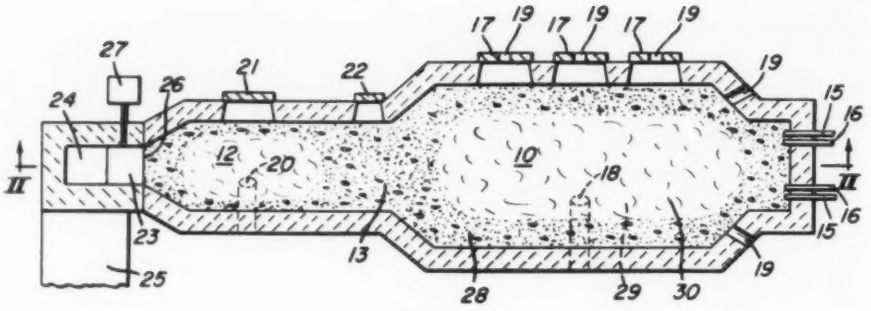


Figure 2

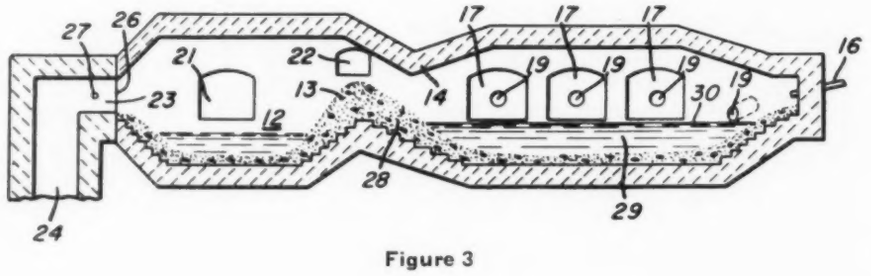


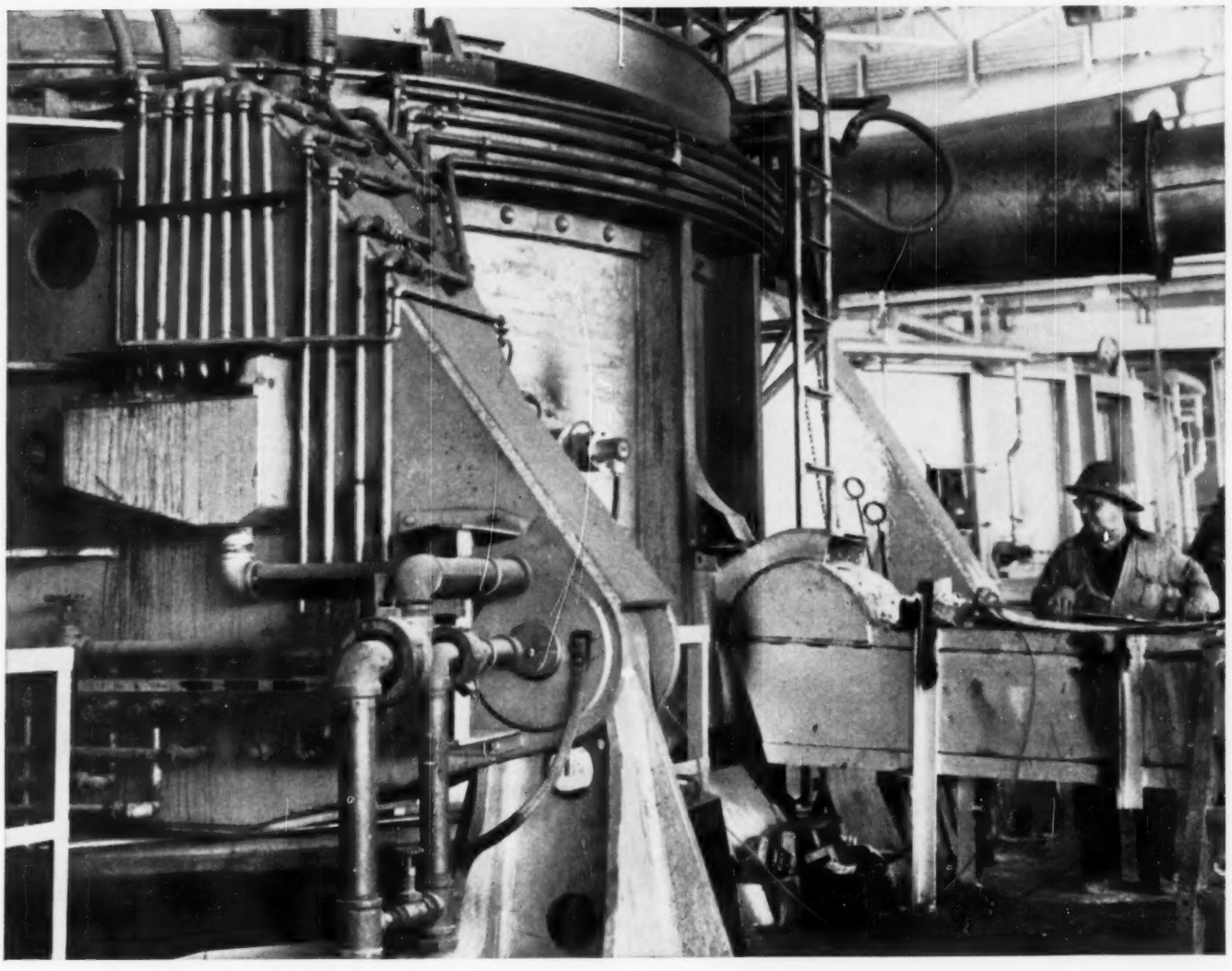
Figure 3

IMPROVED OPEN HEARTH FURNACE FOR MAKING STEEL

△ U. S. 2,820,706, issued Jan. 21, 1958 to Bernard M. Larsen, assigned to United States Steel Corp., describes an improved open hearth type furnace and method of making steel. The objects of the invention are to permit elimination of sulphur and nitrogen, and to reduce the fuel consumption and time required for each heat.

As shown in Figures 2 and 3, the open hearth is fired from only one end and is nonreversing. It includes a main melting chamber 10 and a slag collecting chamber 12 separated by a bank 13 and a knuckle 14 in the floor and roof respectively. Burners 15 and oxygen inlet pipes 16 communicate with ports in the end of the chamber 10 opposite the bank 13. One side of this chamber contains charging doors 17, and the opposite side has a tap-hole or spout 18. This chamber also has auxiliary oxygen ports 19 situated at the corners, in the charging doors or at other convenient locations. Preferably all the oxygen ports are spaced closely above the bath level of the chamber and the inlet pipes are directed toward the bath at a low angle of incidence. The slag collecting chamber 12 has a slag tap-hole or spout 20 and a door 21 for fettling the slag pocket. The wall above the bank 13 has a door 22 for observation and repair of the bank. The end of the chamber 12 communicates through a port 23 with a downcomer 24, which leads to a waste heat boiler 25. The furnace is tiltable to pour molten metal and slag from the chambers 10 and 12. A sampling means and oxygen recorder 27 of conventional construction are connected to the port 23 to furnish an indication of the free oxygen content of gases leaving the chamber 12. The furnace bottom is surfaced with usual basic bottom materials 28, such as magnesite or double burned dolomite, and its slopes lie at normal angles of repose for these materials. The height of the bank 13 and the slopes of the roof of the chamber 12 and knuckle 14 minimize direct radiation from the chamber 10 from reaching the downcomer 24 and the boiler 25.

The open hearth furnace receives a charge similar to a conventional open hearth charge, except that no ore or scale is included. The ultimate charge consists of



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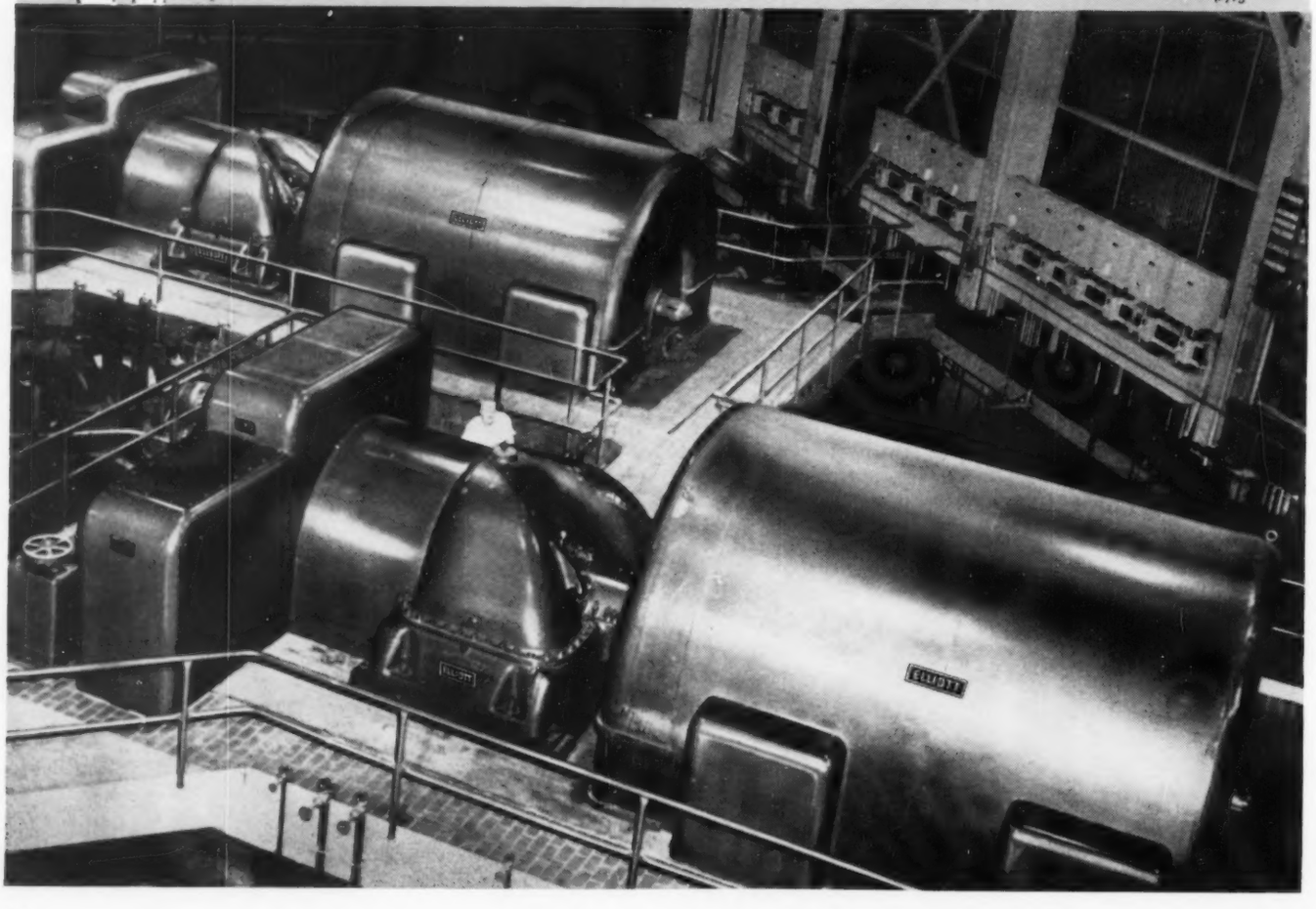


about 60 to 25 per cent scrap and 40 to 75 per cent hot metal, plus the usual limestone or burnt lime flux in an amount equivalent to about 60 to 80 lb. of burnt lime per ton of steel. The flux and scrap are charged first and the latter is melted down by burning liquid or gaseous fuel in the burners 15 with commercially pure oxygen introduced through the ports 16. Neither the fuel nor the oxygen is preheated, and no regenerators are needed. During the early period of heating up the cold scrap, the auxiliary oxygen ports 19 are not used, and the excess oxygen is sufficient only to maintain about 1 per cent free oxygen in the gases leaving the port 23.

After the scrap attains in part a minimum temperature of about 2500 F, ferrous oxide forms its surface and becomes liquid. Thereafter the bath absorbs oxygen more rapidly, and additional oxygen is introduced through some of the auxiliary ports 19. The oxygen absorbed in this period should be sufficient to oxidize all the silicon and part of the manganese in the hot metal charged later. Consequently stored-up oxygen largely eliminates any subsequent "dead bath" period. During this absorption stage, the gases leaving the port 23 should contain about 2 to 5 per cent free oxygen. Essentially all the oxygen absorbed is used to burn iron with such a large heat evolution that the rate of scrap melting is accelerated materially. The auxiliary oxygen supply insures an oxygen pressure at much of the melting scrap-gas interface sufficiently high so that sulphur passes into the gas phase as SO_2. High sulphur scrap may thus be used, since up to 1/2 to 2/3 of its sulphur content is eliminated. As soon as the scrap is "melted flat" or when enough oxygen has been absorbed for silicon elimination from the subsequent hot metal addition, auxiliary oxygen introduction is temporarily reduced or discontinued.

Somewhat before the scrap is completely melted, hot metal is added to the charge. At the conclusion of the melt-down, the charge forms a bath 29, which carries a slag layer 30. Silicon and manganese commence to oxidize immediately after addition of the hot metal, and a carbon boil also commences very quickly. The rate of auxiliary oxygen introduction again is increased to furnish more oxygen for absorption into the slag and metal of the bath, and to burn carbon monoxide evolved in the carbon boil. At this stage a supply of oxygen is needed immediately above much of the area of the slag surface. The combustion of carbon monoxide furnishes considerable heat and enables the fuel input to be cut back or eliminated. This procedure produces a carbon drop in the bath of about 150 to 250 points per hr. This same steep oxygen gradient at the slag-gas interface causes sulphur elimination as SO_2 from the slag just as it does from the melting scrap, as noted above. Over-all sulphur elimination thus varies from about

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or assignee
2,818,601	1/7/58	Disk-type balling device	United States Steel Corp.
2,818,954	1/7/58	Side guide for conveyors	Armco Steel Corp.
2,819,055	1/7/58	Heat-treating furnace	Holcroft & Co.
2,819,056	1/7/58	Apparatus for heat-treating steel	Induction Heating Inc.
2,819,207	1/7/58	Process for enamelling steel	Republic Steel Corp.
2,819,563	1/14/58	Billet grinder	Crucible Steel Co. of America
2,819,694	1/14/58	Soaking pit curb	Amsler Morton Corp.
2,819,794	1/14/58	Extrusion press mandrel	Baldwin-Lima-Hamilton Corp.
2,819,802	1/14/58	Method of operating soaking pit furnace covers	William A. Hart
2,819,854	1/14/58	Pay-off guide for coil holder	United States Steel Corp.
2,819,891	1/14/58	Nozzle provided with cooling jacket	Huttenwerk Oberhausen A.G.
2,819,901	1/14/58	Knockdown backstop	United States Steel Corp.
2,819,930	1/14/58	Apparatus for removing dust from a hopper	Republic Steel Corp.
2,819,956	1/14/58	Addition agent for treatment of steel	Vanadium Corp. of America
2,819,957	1/14/58	Steel alloys for making magnetic recordings	Firma Stahlwerk Kabel
2,820,002	1/14/58	Coke ovens	Ernst Wolff
2,820,003	1/14/58	Compositions for smoothening metal surfaces	Chem-Metals, Inc.
2,820,004	1/14/58	Current density indicator and control	United States Steel Corp.
2,820,264	1/21/58	Ingot stripper	Birdsboro Steel Foundry & Machine Co.
2,820,466	1/21/58	Apparatus for quenching steel railroad wheels	United States Steel Corp.
2,820,704	1/21/58	Method of improving characteristics of iron oxide agglomerates	United States Steel Corp.
2,820,708	1/21/58	Stainless steel	Armco Steel Corp.
2,820,769	1/21/58	Preparation of hydrogen-nitrogen mixtures from coke oven gas	Stamicarbon N. V.
2,820,999	1/28/58	Crucible support	Burndy Corp.
2,821,000	1/28/58	Exothermic lined feed-head frame for an ingot mold	S.A.R.L. Doithau Produits Metallurgie
2,821,016	1/28/58	Lubricant for use in hot forging and extruding operations	William M. Dickson
2,821,348	1/28/58	Cooling apparatus for metal strip	The Loewy Engineering Co. Ltd.
2,821,377	1/28/58	Guide and clamp for an oxygen lance	Pennsylvania Engineering Corp.
2,821,469	1/28/58	Grate type pelletizing apparatus	Regents of the University of Minnesota
2,821,473	1/28/58	Production of nodular cast iron	Meehanite Metal Corp.
2,821,492	1/28/58	Apparatus for pickling ferrous strip	United States Steel Corp.
2,821,494	1/28/58	Method for controlling carburization	Robert M. Walker, Jr.
2,821,504	1/28/58	Changeover valves for regenerative ovens	Koppers Co., Inc.
2,821,775	2/4/58	Apparatus for inserting connecting nipples into hose	United States Steel Corp.
2,821,939	2/4/58	Car stop	United States Steel Corp.
2,822,077	2/4/58	Belt driven roller conveyor	United States Steel Corp.
2,822,086	2/4/56	Device for packaging coiled material	United States Steel Corp.
2,822,087	2/4/58	Extrusion process	Hugo Lorant
2,822,162	2/4/58	Furnace and quench press	Surface Combustion Corp.
2,822,163	2/4/58	Oxygen lance tube	Pennsylvania Engineering Corp.
2,822,169	2/4/58	Apparatus for continuously centering a moving strip	United States Steel Corp.
2,822,256	2/4/58	Smelting of ilmenite	Quebec Iron & Titanium Corp.
2,822,265	2/4/58	Forgeable high strength austenitic alloy	Babcock & Wilcox Co.
2,822,266	2/4/58	Preparation of nodular graphite iron	Allis-Chalmers Mfg. Co.
2,822,291	2/4/58	Manufacture of welded steel tubing	General Motors Corp.

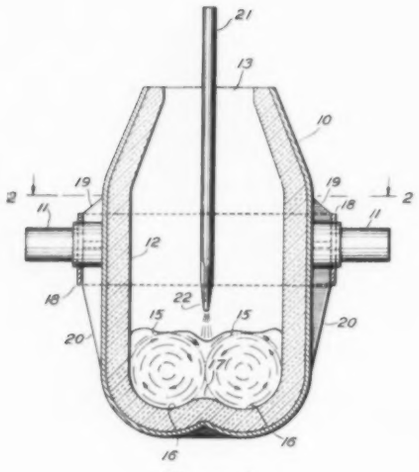


Figure 4

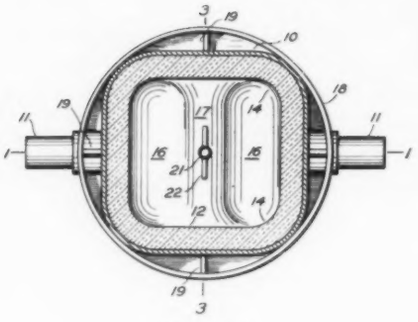


Figure 5

0.008 per cent (of metallic charge) in heats with low-sulphur charges, to around 0.035 per cent in heats with high-sulphur charges. This gives a product much lower in sulphur.

When the carbon reaches a level about 10 to 20 points above that desired at tap, the rate of carbon drop is retarded. This is accomplished by reducing the auxiliary oxygen and by raising its jet stream so that it does not impinge directly on the slag surface, and thus reduce oxygen absorption into the bath, while yet maintaining a small excess of free oxygen in the gases at the port 23. In this last stage the iron oxide in the slag layer 30 diminishes, and some reversion of both manganese and iron from slag to metal occurs, and there is time for sampling or final slag additions. Sometimes it becomes necessary to discontinue all fuel and cool the bath in this final period.

CONVERTER

△ U. S. 2,820,707, issued Jan. 21, 1958 to John Walker and assigned to Henry J. Kaiser Co., provides an oxygen converter which has controlled circulation of the molten metal charge.

As shown in Figures 4 and 5 the converter contains a ridge or rib 17 which, together with the curved bottom, causes rotation of the molten metal in the directions shown, under impulse of the oxygen blast.

REDUCTION OF IRON ORE

△ U. S. 2,821,471, issued Jan. 28, 1958 to Fredrick B. Sellers, assigned to Texaco Development Corp., describes a process for the reduction of iron ore in the presence of hydrogen produced by the water gas shift conversion of carbon monoxide-containing gases.

A mixture of carbon monoxide and hydrogen is generated by the partial combustion of coal, fuel oil or gaseous hydrocarbons. In this operation, the fuel is reacted with oxygen. Liquid hydrocarbons and solid fuels are ordinarily gasified with added steam to control the temperature within the desired range. The steam further serves to generate hydrogen in the reaction.

The crude hydrogen and carbon monoxide-containing gas from the partial oxidation zone is passed with steam to a water-gas shift-reactor containing a catalyst consisting of iron ore particles. The temperature of the water-gas shift conversion zone is maintained with the range of about 600 to 1000 F. The iron ore particles are maintained in a fluidized bed in the shift reactor and ore is continuously added and withdrawn to maintain high catalytic activity. Between about 90 and 95 per cent of the carbon monoxide in the inlet gas stream is reacted with the steam to produce carbon dioxide and additional hydrogen according to the following equation:

$$CO + H_2O \rightarrow CO_2 + H_2$$

Effluent from the water gas shift reaction is scrubbed with a solvent to remove carbon dioxide. The resultant gas stream containing at least 90 per cent hydrogen is supplied to the recycle system of the ore reducer as make-up for the hydrogen consumed in the reduction.

The flowsheet of the process is shown in Figure 6.

HOT TOPS

△ U. S. 2,821,758, issued Feb. 4, 1958 to Enn Vallak, relates to hot tops for ingot molds.

As shown in Figure 7, the hot tops described in this patent are formed from powdered or granular material and are porous. This permits the escape through passages 3 of gases formed during charring of the hot top. These gases are then collected and vented through one or more pipes 5. The gases discharge against the top surface of the ingot in the mold, causing the gases to burn, thus heating the charge.

Figure 6

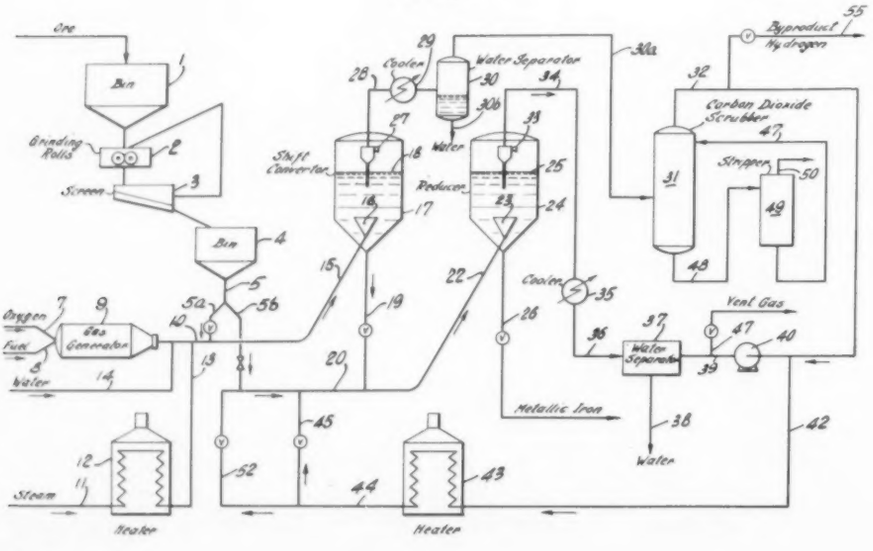
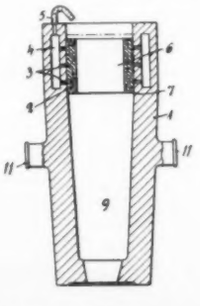
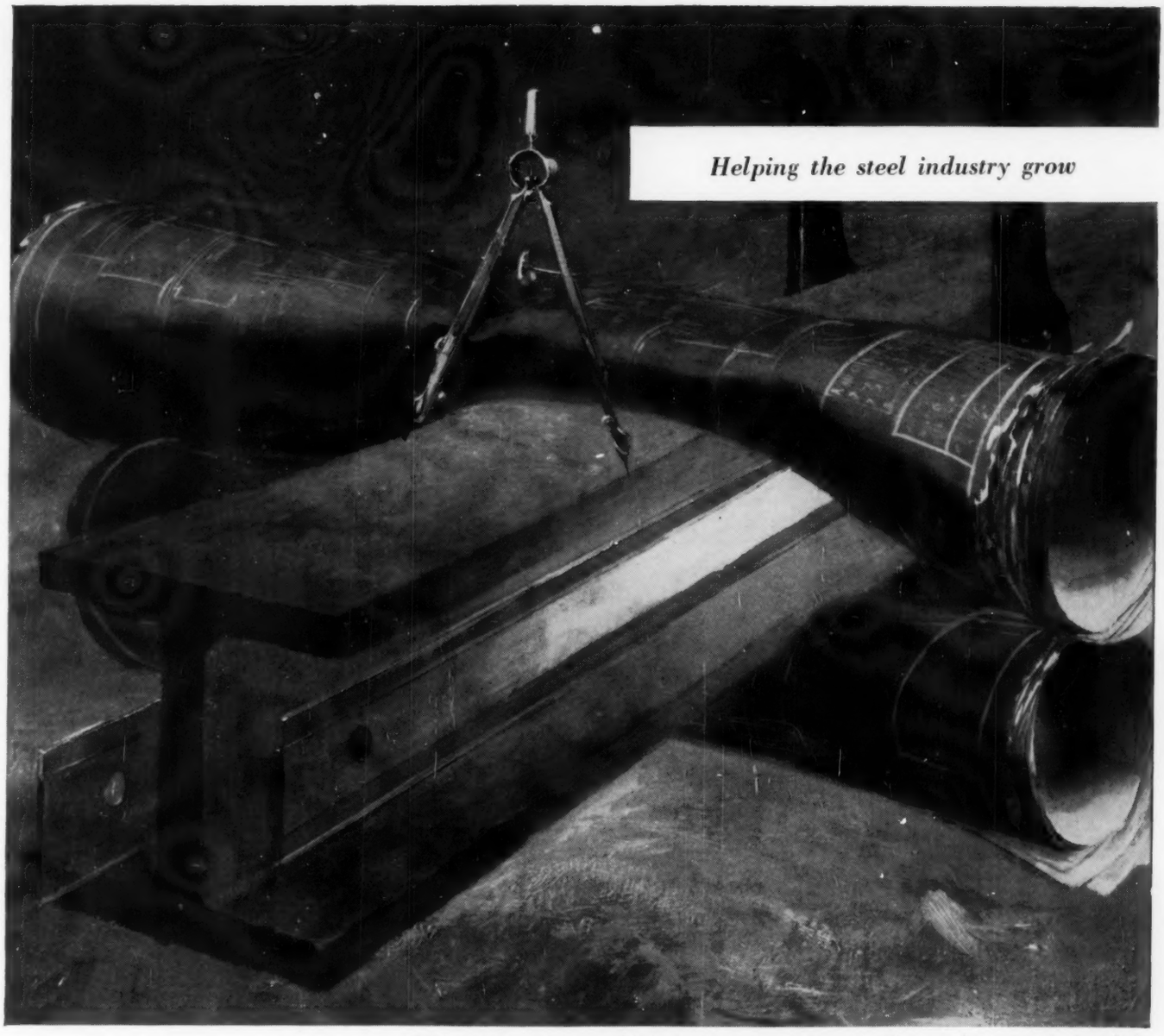


Figure 7





Steel is basic, and the steel industry is constantly increasing its capacity to supply America's dynamic economy. Here the art of Stanley Meltzoff symbolizes the engineering experience and production skills which keep the nation well ahead in output of this vital metal.

Constructing in Five Dimensions

Many projects must be executed not only in the conventional three dimensions, but also within the inflexible limits of time and budget. Our skilled and experienced team has proved many times its ability to complete a project on schedule and at a cost both reasonable and controlled. The range of our services is broad and flexible; facilities can be adapted precisely to moderate or extensive needs.

We have served many of the country's leading steel producers, designing and installing such facilities as rolling mills, slab heating furnaces, sintering strands, desulfurizer stations, oxygen plants, power plants, and coal handling equipment.

Our many new assignments from clients previously served speak for the caliber of our past performance. Our more than 70 years' experience assures you of maximum return on each dollar expended. We invite you to share and profit from this background.

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& Constructors Inc

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Designers • Constructors • Consulting Engineers

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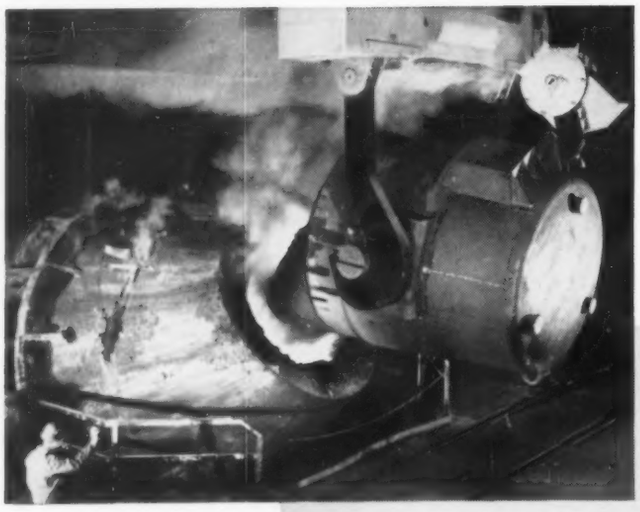
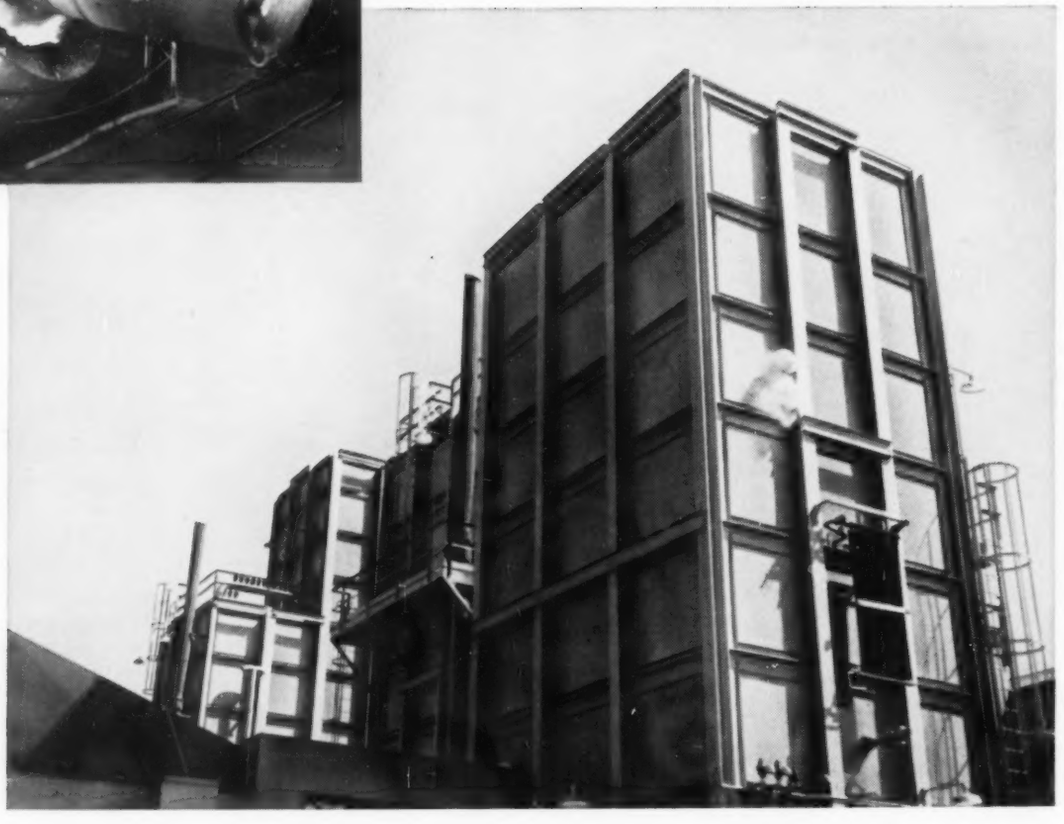
BIG THINGS are happening at Jones & Laughlin

New Basic Oxygen Furnaces at Jones & Laughlin's Aliquippa Works ... the world's largest ... wouldn't have been possible 10 years ago. The price of oxygen was too high.





Thanks to a technical break-through* in oxygen manufacturing by Air Products, Jones & Laughlin will have the lowest cost oxygen available even 10 years from now.

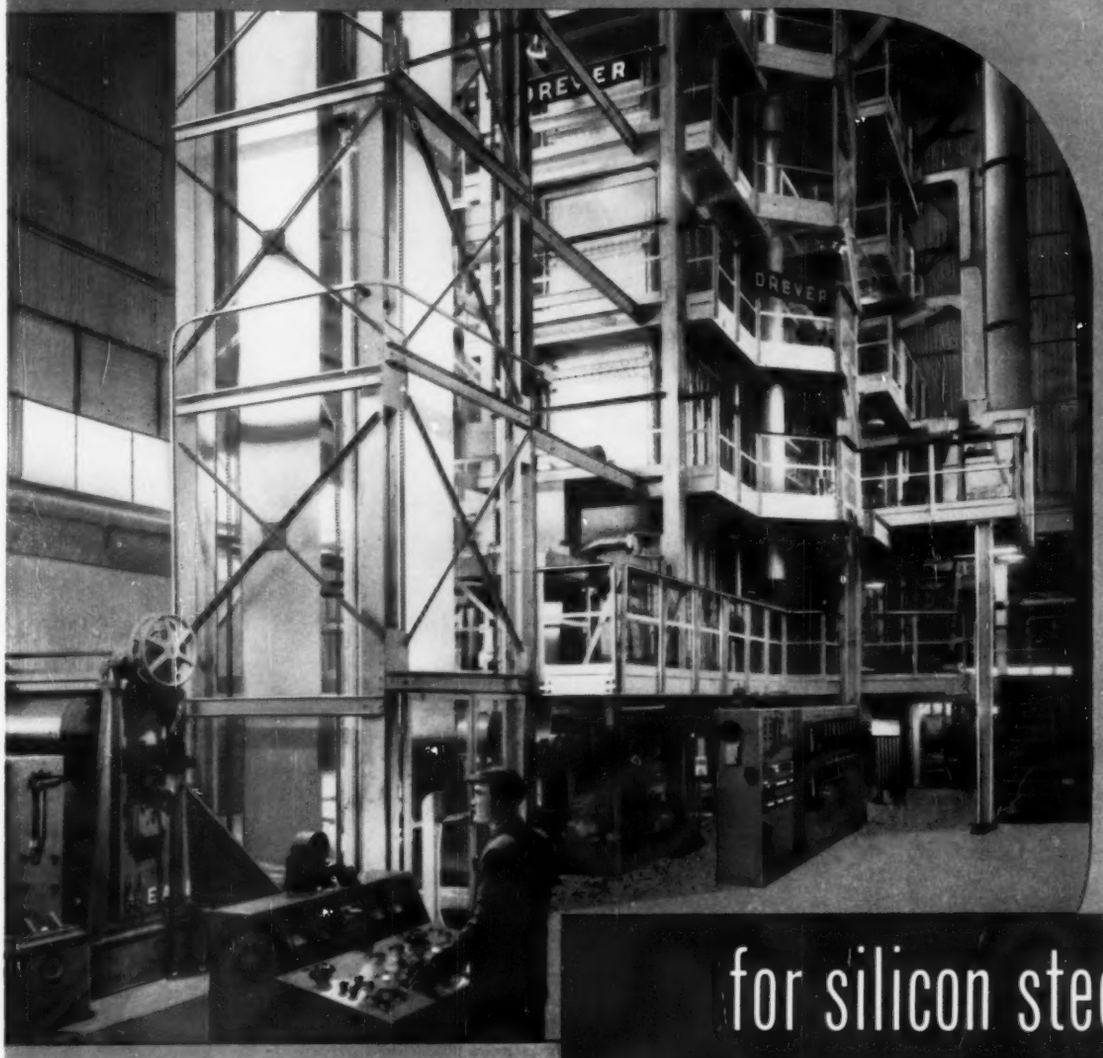
The new oxygen process is the result of Air Products' dedicated efforts through the years to improve oxygen supply at lowest cost. Because of this effective work, oxygen is now widely used rather than remaining the high priced specialty of a limited few.

Jones & Laughlin benefits now from low cost oxygen with maximum reliability of supply. An extra benefit is by-product, ultra-high purity nitrogen. Why not investigate this superior system for your needs today?

**For full details, drop us a line.*

Air Products
...INCORPORATED
Allentown, Penna.

DREVER Continuous Strip Annealing Furnace Line



for silicon steel

Delivery end of Drever gas-fired radiant tube heated vertical annealing furnace for silicon steel strip installed at Empire Steel Corporation, Mansfield, Ohio.

This furnace was designed and installed by the Drever Company to produce 8 tons per hour of silicon steel strip. The heating and soaking zones are gas-fired radiant tube heated; the tubes having a connected load of 13,500 CFH of natural gas.

The furnace has been engineered to handle silicon steel strip in thicknesses from 0.017" to 0.025", in widths from 24" to 42", and for speeds from 60 to 180 FPM.

Drever continuous annealing lines for Tin Plate, Galvanized Stock, other Low Carbon Steel and Non-Ferrous Strip in capacities up to 30 tons per hour, provide an economical investment in tonnage production of quality material.

DREVER COMPANY

Red Lion Rd. & Philmont Ave.

BETHAYRES, PA.

38

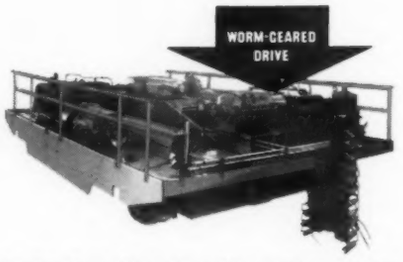
Crane control so exact you can polish your car

Polishing a $5,000 Mercedes-Benz with a cloth wrapped around a crane hook takes perfect control. Foolish idea? Not really. The hot and cold steel you handle and the equipment nearby are worth many times the cost of a quality car. That's why the total control provided by Shaw-Box is so vitally important to mills.

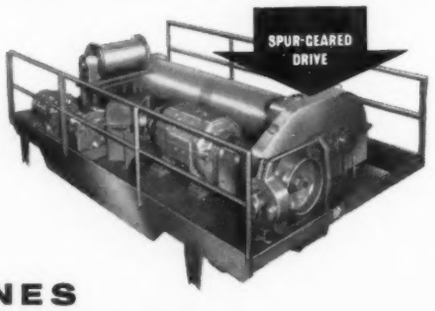
Shaw-Box Builds Cranes to AISE Specs or Your Own

You name the crane — any type, any size — Shaw-Box has the design and engineering experience and the facilities to meet AISE or your own specifications. You get total crane control that means everything in precision operation — everything in safety for man, load and crane. You can be sure of low maintenance and low power consumption. We assure complete dependability and highest performance regardless of service conditions.

Call in one of our engineers. He will gladly discuss specifications and tell you about our standard AISE designs for 5 to 500-ton cranes. Your inquiry is invited.



Prefer Spur-Geared or Worm-Geared Drive? Shaw-Box can meet AISE or your requirements exactly, whichever type is best for your application.



58K-2

"Shaw-Box"® CRANES

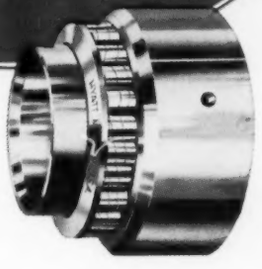
MAXWELL MANNING & MOORE INC. M&M TRADE MARK

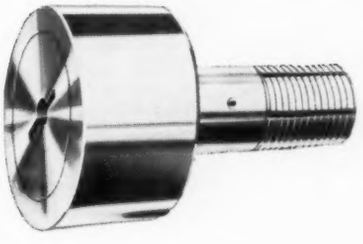
MANNING, MAXWELL & MOORE, INC.
SHAW-BOX CRANE & HOIST DIVISION
388 W. Broadway • Muskegon, Michigan

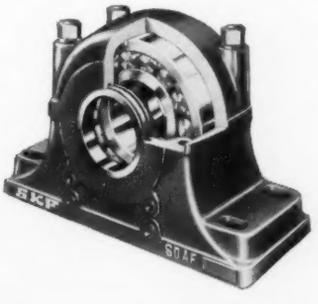
Builders of "SHAW-BOX" and LOAD LIFTER' Cranes, 'BUDGIT' and 'LOAD LIFTER' Hoists and other lifting specialties. Other Divisions produce 'ASHCROFT' Gauges 'HANCOCK' Valves, 'CONSOLIDATED' Safety and Relief Valves, and 'AMERICAN' and 'AMERICAN-MICROSEN' Industrial Instruments.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

We'd have been in a jam!







Recently, one of Berry Bearing Company's customers had a sudden, unanticipated critical bearing failure. Production stopped immediately--just when a large, urgently needed order was practically completed. And, no replacement bearing was in stock.

A quick, S.O.S. phone call to Berry Bearing resulted in fast action. The needed bearing was not only delivered...but...was being installed--in less than an hour after the phone call! "We'd have been in a jam," the customer said, "if you hadn't lived up to your reputation for--Immediate Delivery."

Like this grateful customer, you'll get immediate delivery on every order you place with Berry Bearing Company--whether you're faced with a production crisis or not. With over 50,000 different types and sizes of bearings, bearing specialties, and transmission appliances regularly in stock, Berry can fill your order for *anything* you need--generally in approximately 27 minutes, anywhere in the Chicagoland industrial area.

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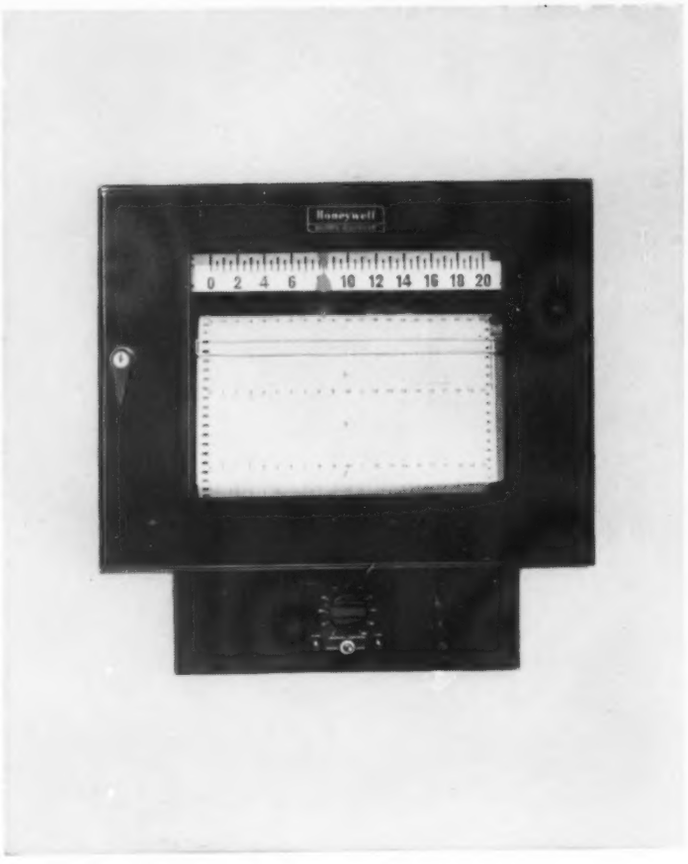
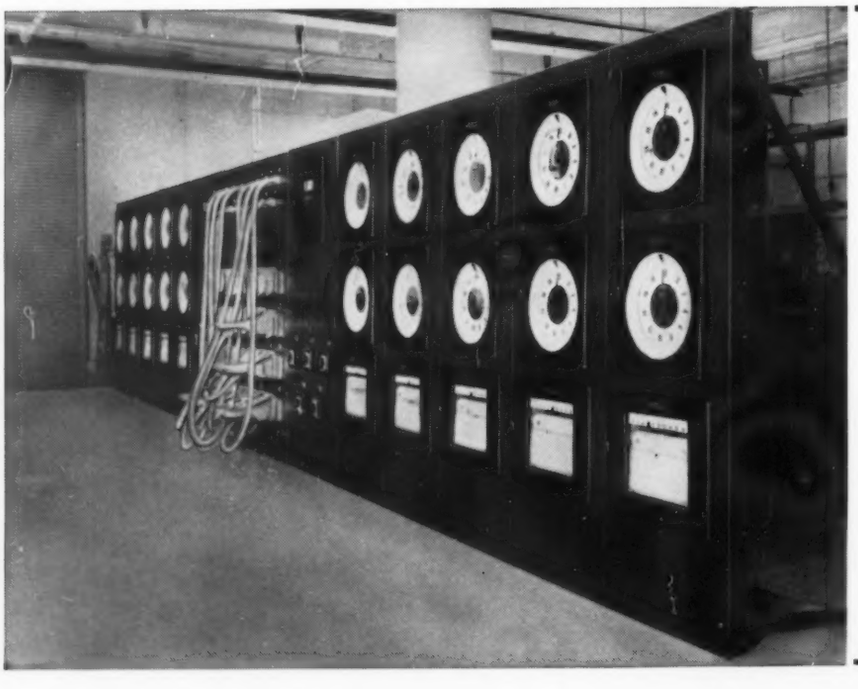
LUdlow 5-4400	EUclid 6-1700	ORchard 4-6600	Phone 2-5561	WEstmore 1-3010	TUrner 5-7501

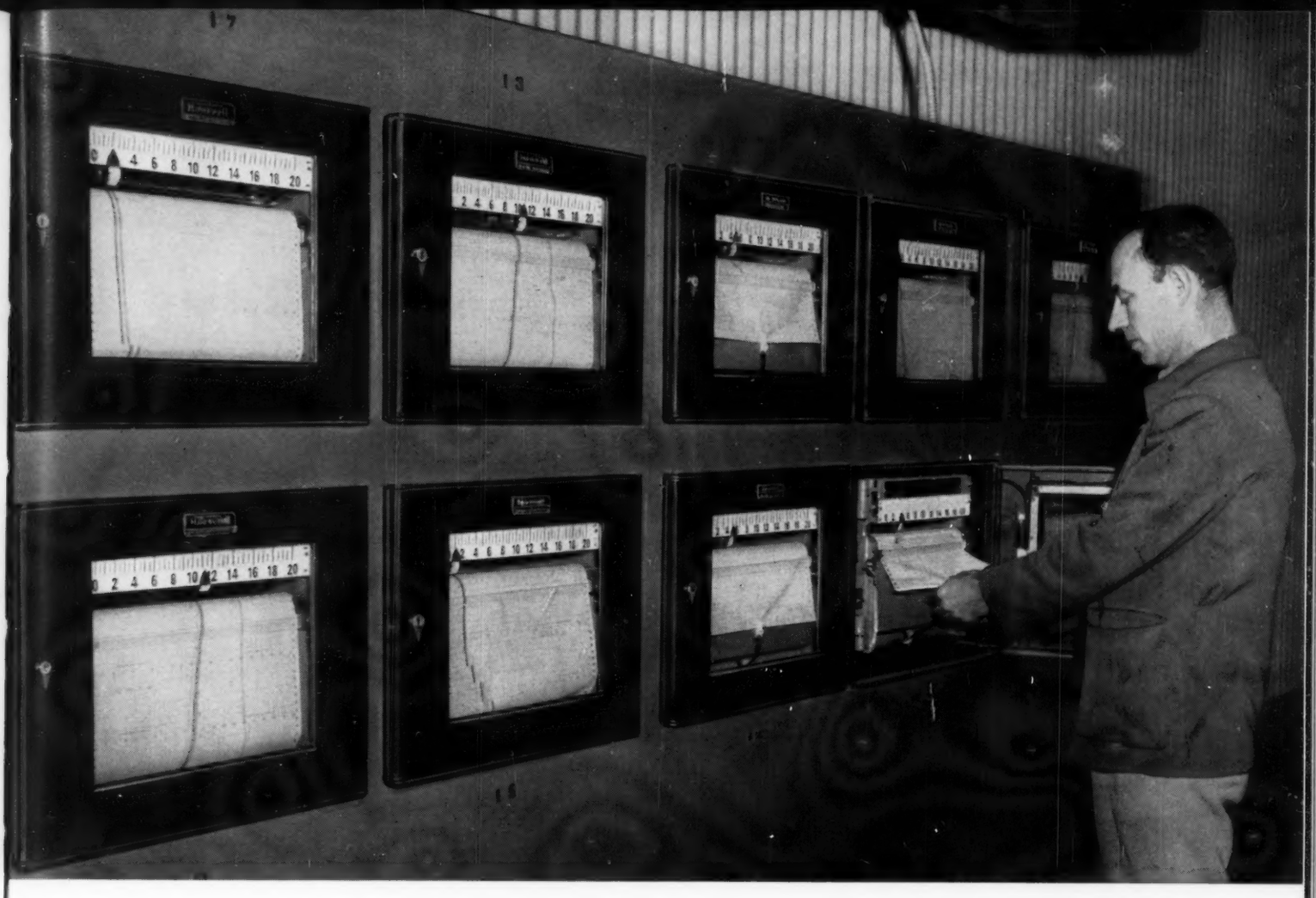


Honeywell annealing cover control system used by most major steel plants has centralized recording and unit cover and work control. At right is the panel of ***ElectroniK*** strip chart instruments which record base and work temperatures in each furnace.

For maximum production on every



Typical Honeywell central control system for an annealing cover installation has circular scale indicating controllers and strip chart recorders, with plug-in connections to covers being used.



heat...use *ElectroniK* instrumentation on your annealing covers

Cover-type furnaces for annealing, normalizing and spheroidizing provide optimum rates of heating, soaking and cooling when controlled by Honeywell *ElectroniK* potentiometers. Fuel savings are an added advantage.

Honeywell supplies controls to suit any specific requirement of radiant tube and direct-fired type furnaces. Controls are custom-fitted to give the fastest cycles consistent with recommended practices. This means you get precise temperature control needed for maximum production and accurately predictable product quality.

ElectroniK instruments are rugged. Mount them on portable covers without fear of damage or loss of performance. Long runs of thermocouple wire won't affect their sensitivity. Safety interlocks protect covers in event of set-point change or power failure.

You have a wide choice of systems. Control can be on-off or proportional . . . electric or pneumatic. There are systems to exactly match the requirements of various cover designs, heating methods and furnace operating procedures . . . including fully automatic programming.

Call your nearby Honeywell field engineer for a discussion of your needs. He's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Data Sheet 5.2-6a, "Annealing Cover Temperature Control Systems".**

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In parallel shaft drives . . . look for

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Ball and roller bearings are of ample size and capacity to withstand shock and overloading.

Under the shocks and overloads that are often encountered by parallel shaft gear drives, rugged housing construction is vital if shaft alignment is to be maintained. That's why Link-Belt adds special reinforcement at points of greatest stress . . . has developed this design expressly for endurance in heavy-duty service.

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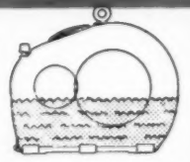
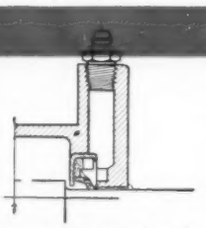
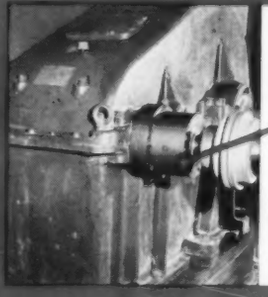
You'll find it . . . and these "plus" performance features . . . when you specify LINK-BELT

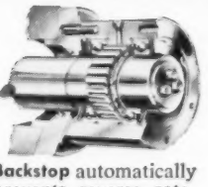


Automatic splash lubrication reliably supplies oil to all gears and bearings.



Grease-lubricated seals on all input and output shafts prevent entrance of dirt, water.





Backstop automatically prevents reverse rotation of output shaft due to power stoppage or other causes.

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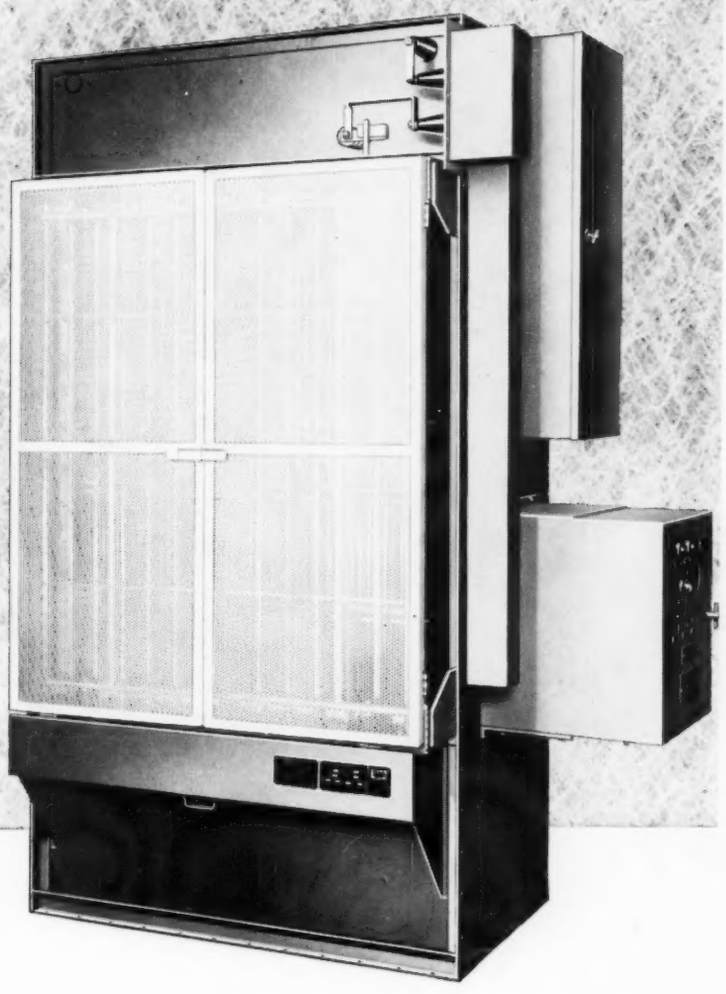
AMER-*glas* pre-cleaner optional on all AAF *Electro*-MATIC air filters!



AAF "MIRACLE" MATERIAL reduces dirt load on precipitator

AAF's super-efficient electrostatic precipitator—Electro-MATIC—is now available with a built-in pre-cleaner (optional in place of standard perforated baffle). Made of AMER-glas—AAF's miracle glass fibre filtering material—this new pre-cleaner will substantially reduce dirt load on the self-cleaning Electro-MATIC.

Simple replacement of AMER-glas pads restores pre-cleaner to maximum efficiency. Ask your local American Air Filter representative for complete information on Electro-MATIC's optional AMER-glas pre-cleaner, or write us direct.

AAF Dust Control Equipment

Illinois Heating Specialties

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We know roughly 25 iron and steel plant applications where bearing and other bronze parts may be costing you too much. Here are a few:

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For applications like these, NBD makes a special kind of casting—long lasting, efficient, perfect for the service, but much less expensive than machined bearings or parts.

We call these castings *precision cast-to-size.* They cost you less because no one ever puts a machine tool to them (except for drilling and tapping). Oil grooves are cast in.

You can have your choice of alloy. Or take our recommendation.

Size and weight are not a problem. We'll cast your bearings or other parts ready to use as you receive them.

Let's talk about costs and applications in your mill. Call or write.

AMERICAN Brake Shoe COMPANY

NATIONAL BEARING DIVISION

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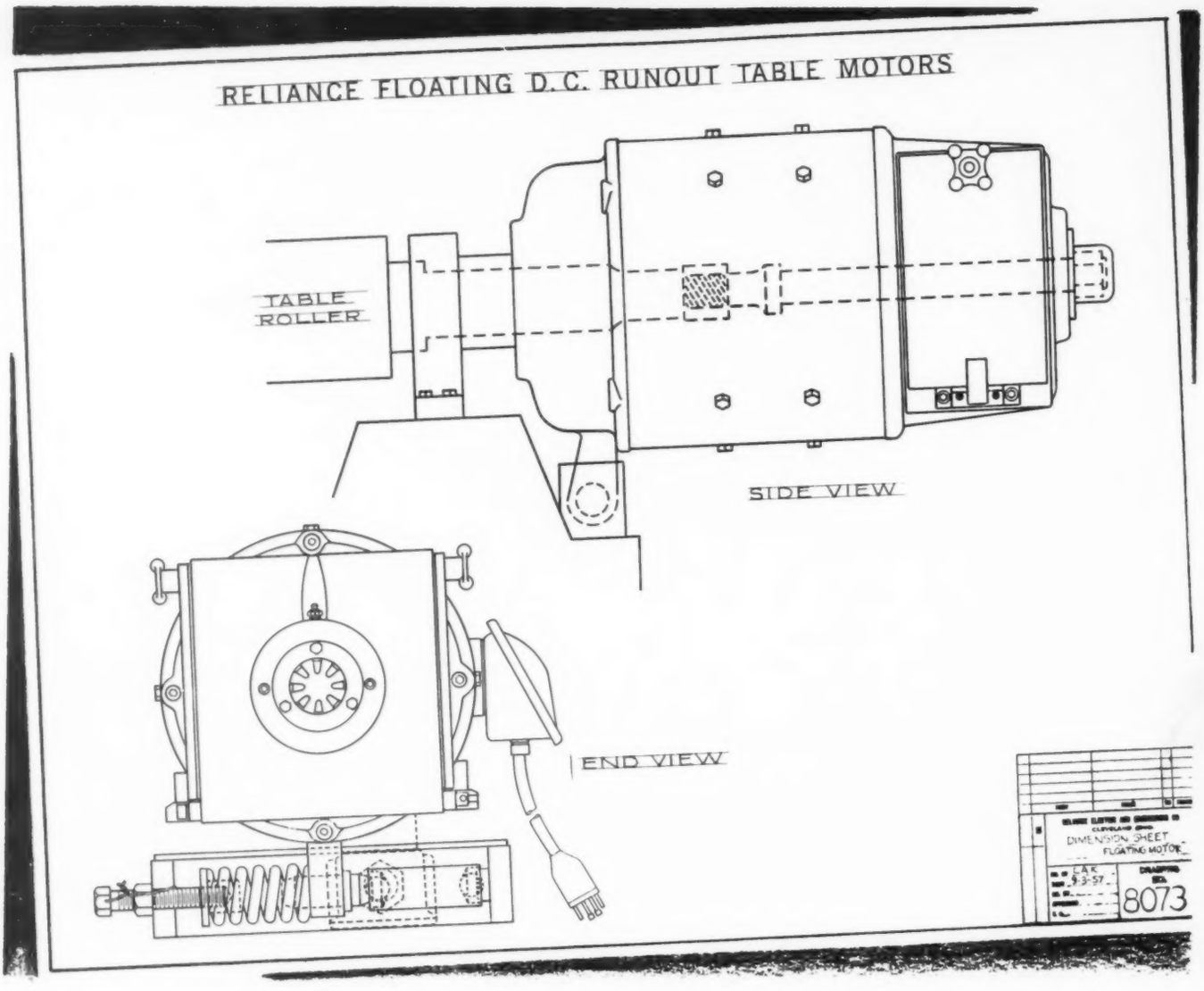

Reliance runout table motors cut installation and maintenance costs

Reliance Hollow Shaft, floating motors are easy to install. They require no special pedestals or flexible couplings.

The hollow shaft motors fit right over the table-roller shaft. No special alignment is required. Warpage and backlash compensation are handled by the heavy tie-down spring. Not only are coupling maintenance and lubrication eliminated, but a much greater degree of roller misalignment can be tolerated.

Reliance Floating motors are designed and built specifically for runout table service. They are available with a wide range of speeds and out-put torques. For complete information contact your local Reliance Representative, or write for Bulletin No. F-2051. C-1587

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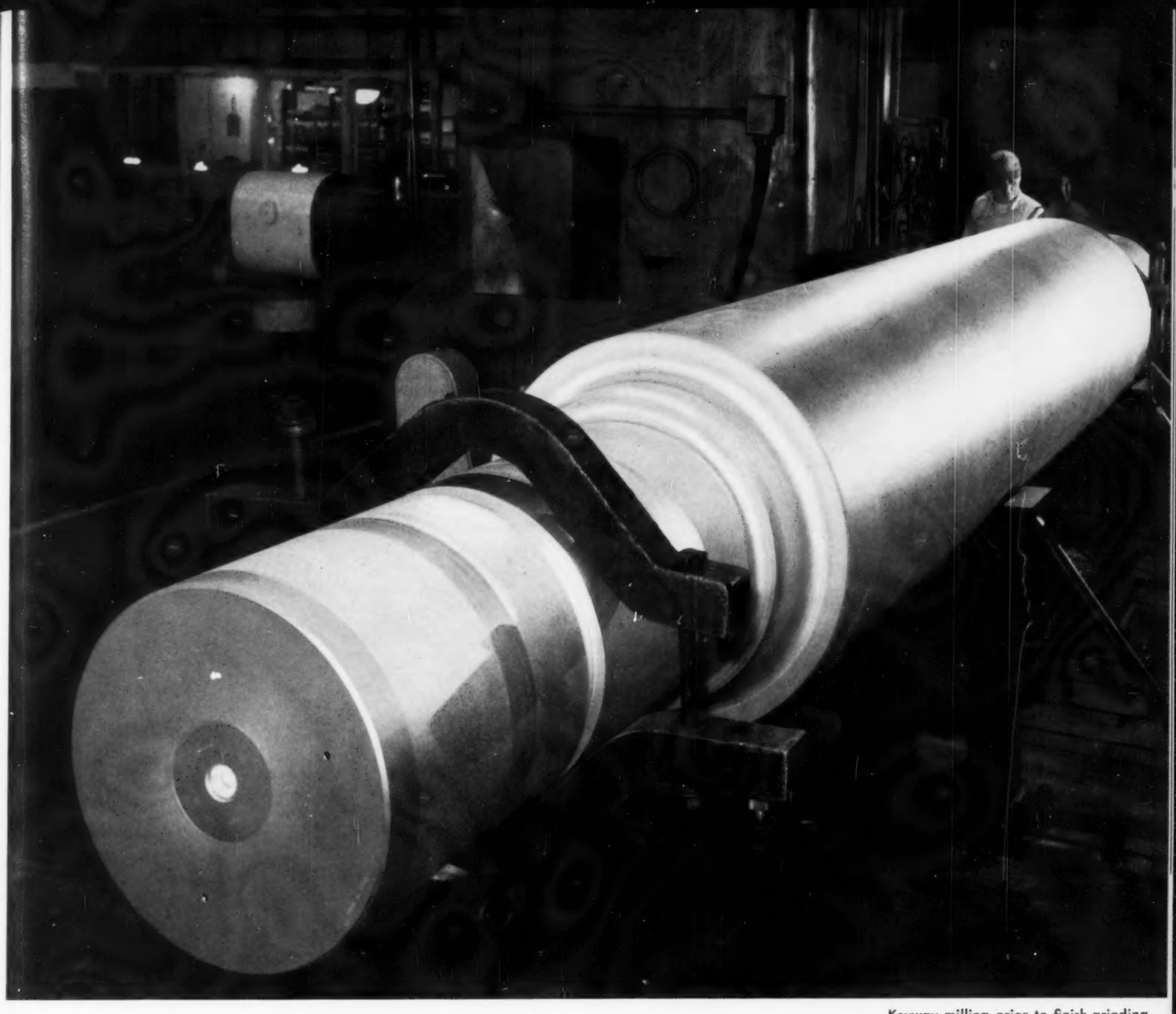


Keyway milling prior to finish-grinding.

It sets a new record

This isn't the largest forging ever to come from the Bethlehem shops. But it *is* the largest forged work-roll we've ever produced for rolling of metals.

Its weight is a record 34 tons. And its length is even greater than the photo might indicate. From end to end the roll measures just about 24 ft. It has a working face of approximately 14 ft and a body diameter of 38 in. When finished and installed, it will be used for rolling aluminum plate and sheet.

In contrast, Bethlehem often makes rolls so small that they can be lifted by hand. You can get virtually *any* size or type of forged, hardened roll, simply by giving us specifications. Whether you need one roll or a hundred, Bethlehem can do the job right—and prices are always competitive.

TYPICAL USES FOR BETHLEHEM FORGED-STEEL ROLLS

- **Cold-rolling ferrous sheets and strip**
- **Running-down and finishing operations on copper and brass sheets**
- **Hot- and cold-rolling aluminum sheets**
- **Cold-rolling aluminum foil**

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

3 new applications get longer life and minimum maintenance using Dodge pillow blocks with Timken® bearings

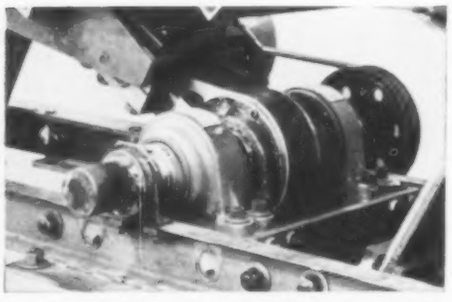
PICTURED below are three applications where Timken bearing equipped Dodge pillow blocks stay on the job with little attention under tough conditions. Their tapered design lets Timken® bearings take *both* radial and thrust loads in any combination. And full-line contact between rollers and races provides extra load-carrying capacity. Wear is reduced, maintenance is cut to the minimum.

Cutaway view shows the Dodge All-Steel pillow block with Timken bearing mounting. Of special design, the bearing has a tapered bore with self-aligning spherical outer surface —never needs adjustment.

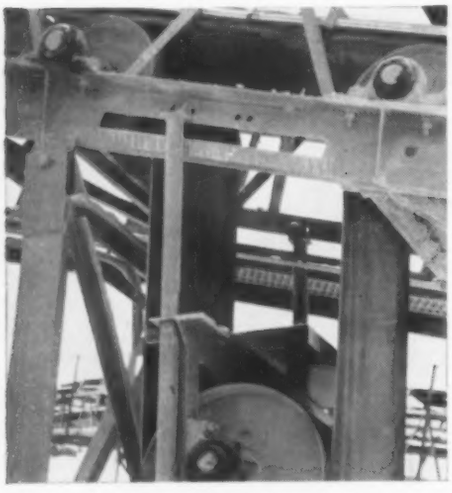
Besides the All-Steel pillow block, other versatile Dodge pillow blocks with Timken tapered roller bearings are: Type "E", Double-Interlock, Type "C" and Special Duty. All are compact in design. Special thrust devices that take up extra space are not needed.

So specify bearings trade-marked "TIMKEN" for the machines you buy or build. They bring Better-ness to any machine because Better-ness rolls on Timken tapered roller bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

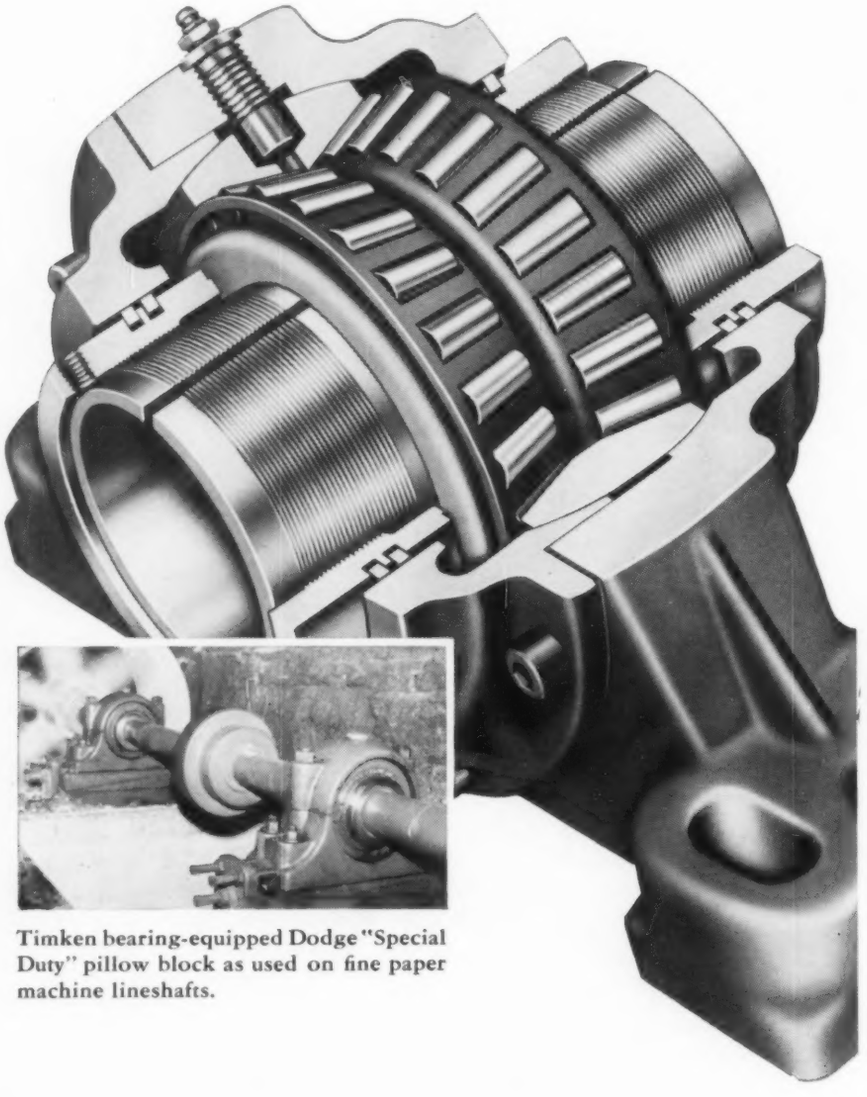
This symbol on a product means its bearings are the best.



Timken bearing-equipped Dodge All-Steel pillow block used in a vibrating conveyor.



Timken bearing-equipped Dodge Type "E" pillow block used in sand and gravel plant.



Timken bearing-equipped Dodge "Special Duty" pillow block as used on fine paper machine lineshafts.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD

How to get maximum combustion efficiency . . . measure <u>both</u> combustibles and oxygen

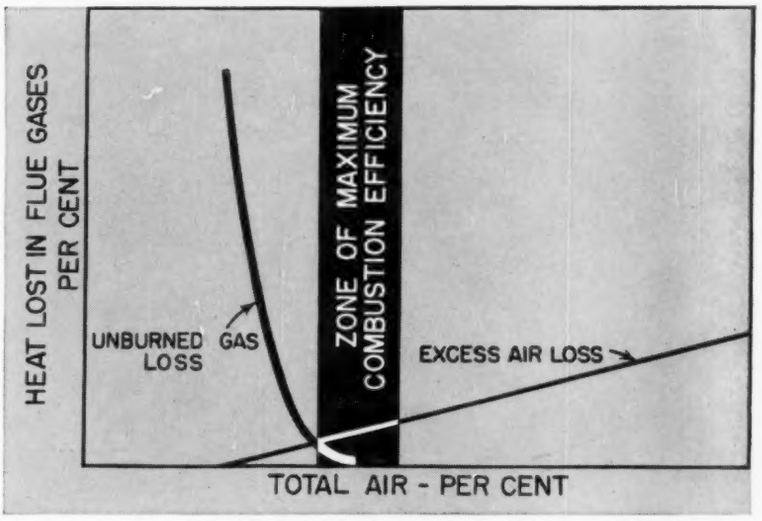
Simultaneous measurement of both oxygen and combustibles is needed to obtain optimum combustion. No instrument that measures only one of these two interdependable factors can give you the full information necessary.

Now, Bailey offers two units, each giving a continuous and simultaneous double check on combustion efficiency: a permanent analyzer-recorder which records both factors on a single chart; and a new light weight, portable unit which indicates both factors.

Both instruments measure: (1) excess air—regardless of the fuel or combinations of fuel being burned, (2) mixing efficiency of your fuel burning equipment by showing per cent combustibles in the flue gas.

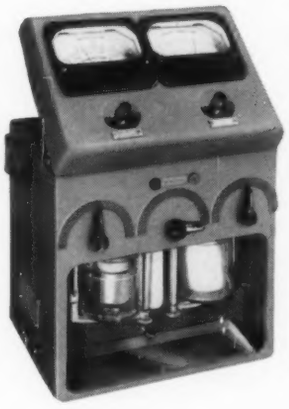
Both units are designed to increase efficiency in the furnace operations of the steel industry, on glass tanks, cement and lime kilns, ceramic and refractory kilns, steam boilers and also on direct and indirect-fired furnaces in the metal processing industries.

To prevent your money from becoming waste gas, look into these two efficiency provers. A Bailey engineer will be glad to give you details or write us for product specifications.


HEAT LOST IN FLUE GASES PER CENT
UNBURNED GAS LOSS
ZONE OF MAXIMUM COMBUSTION EFFICIENCY
EXCESS AIR LOSS
TOTAL AIR - PER CENT

Maximum Combustion Efficiency is secured by keeping the sum of Excess Air Loss and Unburned Gas Loss to a minimum. To do so by the direct method simply measure both oxygen and combustibles in flue gas.

For portable use—
HEAT PROVER Analyzer



The famous Cities Service HEAT PROVER analyzer is now Bailey built and sold. Weighing only 25 pounds, it is a self-contained automatic analyzer including a sampling tip and hose plus a thermocouple for temperature measurement.

Instrument dials are dual range for greater accuracy and sensitivity.

For permanent installation
Oxygen-Combustibles Recorder

The Bailey Oxygen-Combustibles Analyzer-Recorder coordinates both records on one chart. These records enable the operator to keep fuel burning equipment performing continuously in the zone of maximum combustion efficiency. Excess air may be reduced to the point where combustibles begin to show.

G 40-1

Instruments and controls for power and process

BAILEY METER COMPANY

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In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

EC&M Electrical Control

1800-Ton-per-Hour Dravo Unloader in operation at Pennsylvania Railroad's Greenwich Point, Philadelphia, Ore Unloader Pier

Square D Field Engineering Service is available through more than one hundred Square D offices, backed by an international network of over 1000 authorized electrical distributors and 17 plants in the United States, Canada, Mexico and England

Executive Offices • 6060 Rivard Street, Detroit 11, Michigan

EC&M HEAVY INDUSTRY ELECTRICAL EQUIPMENT...NOW A PART OF THE SQUARE D LINE

THE ELECTRIC CONTROLLER & MFG. CO.

A DIVISION OF THE SQUARE D COMPANY

CLEVELAND 28 • OHIO

for Industry's Big, Tough Jobs!

22½ TON BITES!

Everything about this ore unloader is big...and it does a big job with amazing speed. Powered through 20 motors ranging in sizes up to 800 HP, it takes 22½ tons of ore from a ship's hold on an average cycle handling time of 45 seconds!

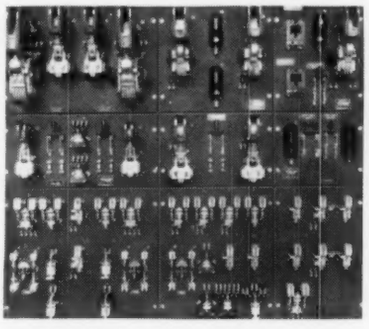
Electrical control equipment does a big job, too, in putting this unloader through its paces. And there's a lot of it. Hoist control, trolley control, bridge control brakes. *All of it is EC&M.*

Consult EC&M when planning adjustable voltage installations

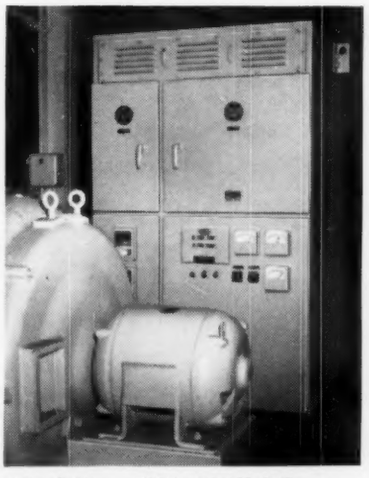
Here is an example of EC&M's control and engineering service in action. These EC&M control panels are mounted in the machinery room, 100 feet above ground level, along with generators which supply DC power for unloader motors. EC&M is geared to supply the complete job including rotating machinery for adjustable voltage and constant potential drives.

Photos courtesy Dravo Corporation, Elliott Company, and the Pennsylvania Railroad

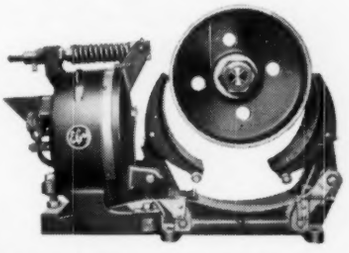
EC&M PERFORMANCE-PROVEN
CRANE EQUIPMENT



EC&M Adjustable Voltage Control Panel (mounted on trolley) for Hold and Close Line Motors and for Trolley Motor, plus Protective Panel for other drives



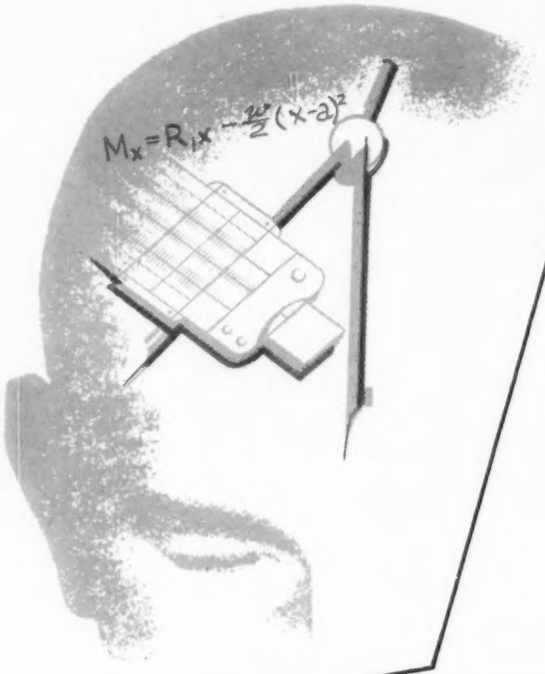
EC&M Type ZHA 4160 Volt Starter provides pushbutton starting of 800 HP Elliott synchronous motor driving 4 generators

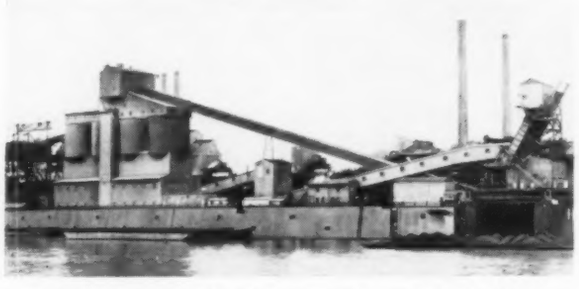


EC&M Type WB Brakes—designed for fast response in releasing and setting. 100% lubrication insures exceptionally long life

CREATIVE ENGINEERING

can give you a greater return from your investment in material handling facilities.





2000 TONS OF COAL PER HOUR
from barges—to blending bins—to coke ovens

You can be sure of greater economy and more efficient performance of your material handling facilities when you call on the progressive engineering skill of Roberts & Schaefer.

The unusual and the difficult are always a challenge to R&S engineers. Original thinking has contributed to their reputation for engineering and construction of material handling facilities which meet the most critical specification requirements for performance, flexibility and economy.

Creative engineering has always characterized design and construction by Roberts & Schaefer Company—a business organization built on repeat orders from customers who got what they wanted the first time.

R&S material handling plants, simple or elaborate, are engineered with processing, distributing and storage systems, complete with crusher, screens, conveyors, scales, car dumps, skip hoists, preparation and drying equipment – and with the capacity to give you the maximum return on your investment.

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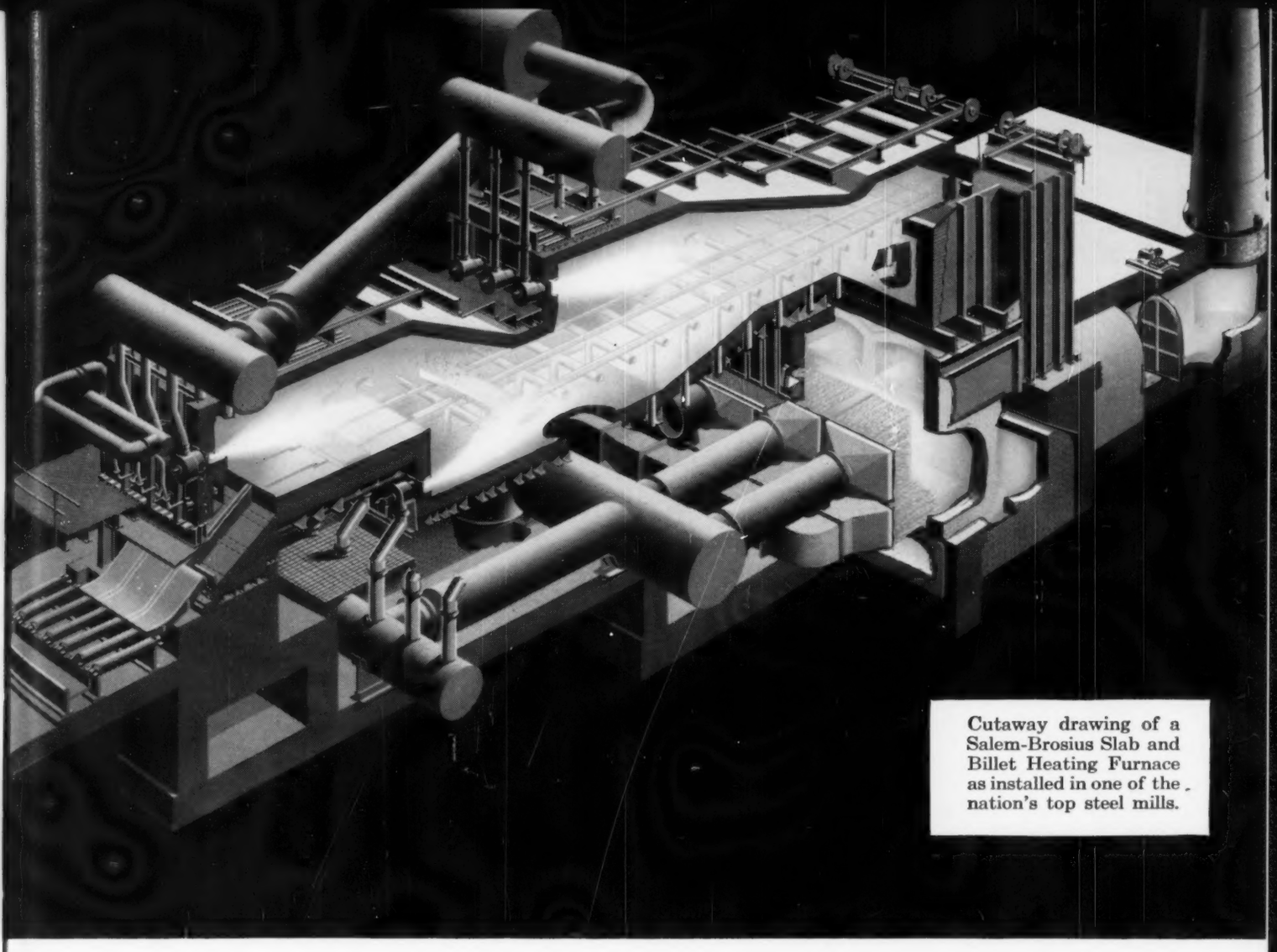


Cutaway drawing of a Salem-Brosius Slab and Billet Heating Furnace as installed in one of the nation's top steel mills.

In this Salem-Brosius furnace better steel products are born

All over the country, steel producers are turning to Salem-Brosius Pusher-Type Slab and Billet Heaters, because they have come to know that these furnaces will produce maximum tonnages of evenly heated, accurately temperatured steel at the lowest fuel consumption rate. The triple-fired furnace shown above features accurately controlled heating and soaking zones, heavy construction, recuperators for fuel economy, dual gas-oil fuel system, low maintenance cost, and many other advantages. These assure positive, automatic control of furnace output and heating quality.

And the efficiency, economy, ease-of-operation, and trouble-free service this furnace affords are typical of all the furnaces Salem-Brosius builds. Whether you require this or any other heating or heat treating furnace, Salem-Brosius offers equipment designed, engineered, and built not merely as a furnace but as a heating machine. You can purchase these furnaces as complete installations—equipped with all controls, piping and wiring—ready to operate. Write to us.

SALEM-BROSIUS, INC.

CARNEGIE, PENNSYLVANIA

In Canada: Salem Engineering Limited • 1525 Bloor Street West, Toronto 9, Ontario

SPECIAL MECHANICAL EQUIPMENT • INDUSTRIAL HEATING FURNACES • MATERIALS HANDLING EQUIPMENT

7½ TON
AUX. HOIST
40 TON
MAIN HOIST

Here's an AC Mill Crane doing traditional DC Crane work

It's a P&H AC mill crane, one of a growing number in steel-mill service. It moves dies to and from the press — and feeds raw stock into a giant manipulator which handles huge billets.

An important reason for the rising popularity of P&H AC mill cranes is P&H Electronic "Stepless" Crane Control. Electronically-controlled AC cranes operate at higher speeds than DC types — and can glide down to as low as 10% of full-load rated speed. This superior control of crane operations eliminates load sway and jerky "inching" — provides the right speed for lifting, moving, and positioning—and greatly reduces crane maintenance and parts inventory.

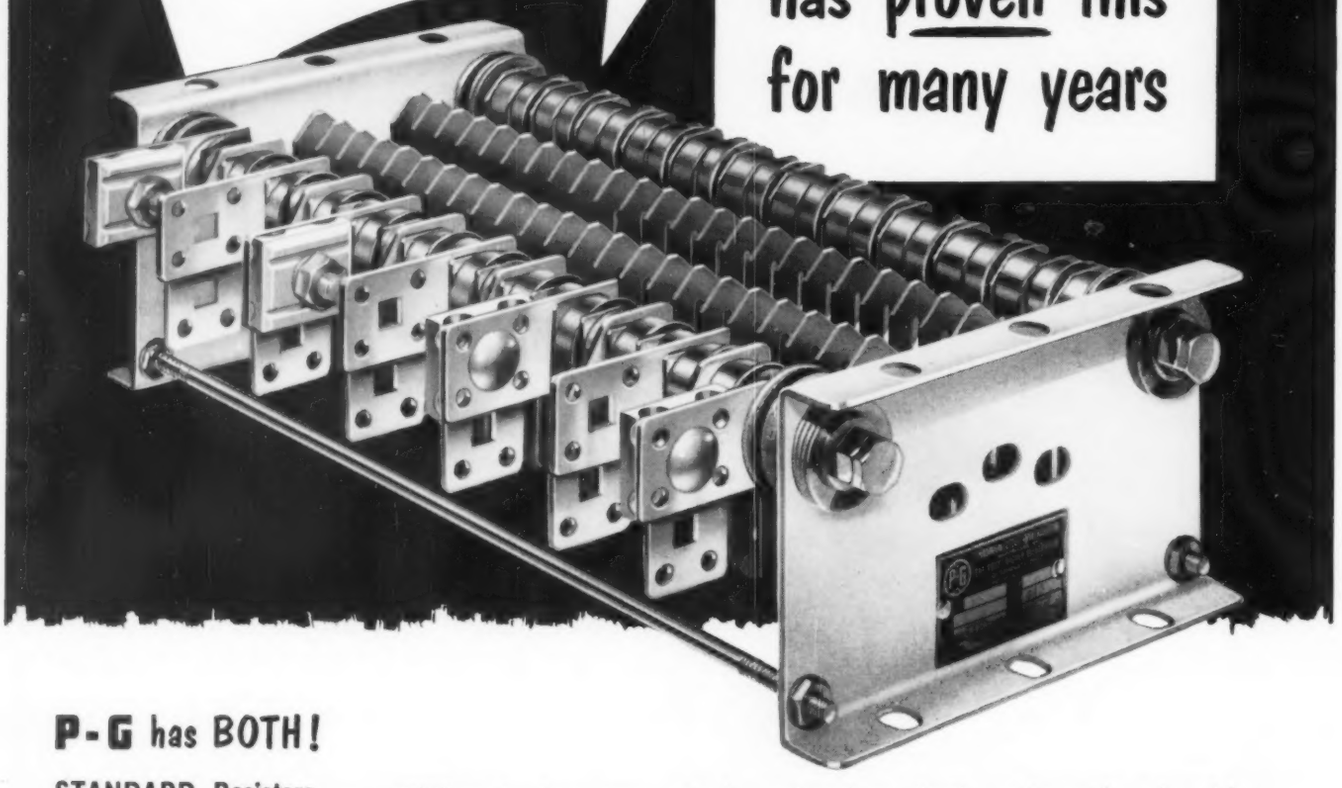
Check the many benefits that P&H AC mill cranes with P&H Electronic Crane Control offer you. Find out, too, how this remarkable control can update your existing AC crane—regardless of size or make — then specify it in your next crane inquiry. For information, write Dept. 129G, Harnischfeger Corp., Milwaukee 46, Wis.

HARNISCHFEGER

P&H ... quality and service for 74 years

There is a *difference* in Resistors

P-G the ORIGINAL Steel Grid Resistor has proven this for many years



P-G has BOTH!

STANDARD Resistors

WELDED Resistors

Write for Bulletins

Different, because steel and mica, both extremely durable materials, coupled with P-G exclusive design produce a resistor of great mechanical strength. There is nothing to break. With accurate resistance values and adequate carrying capacities, P-G Resistors outlast ordinary resistors. Tell us your specifications and let P-G solve your resistor problem.

The Nonbreakable Steel Grid Resistor

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ESTABLISHED 1892

THE **POST-GLOVER** ELECTRIC COMPANY

OFFICE and FACTORY—Kenton Lands Road, Erlanger, Kentucky

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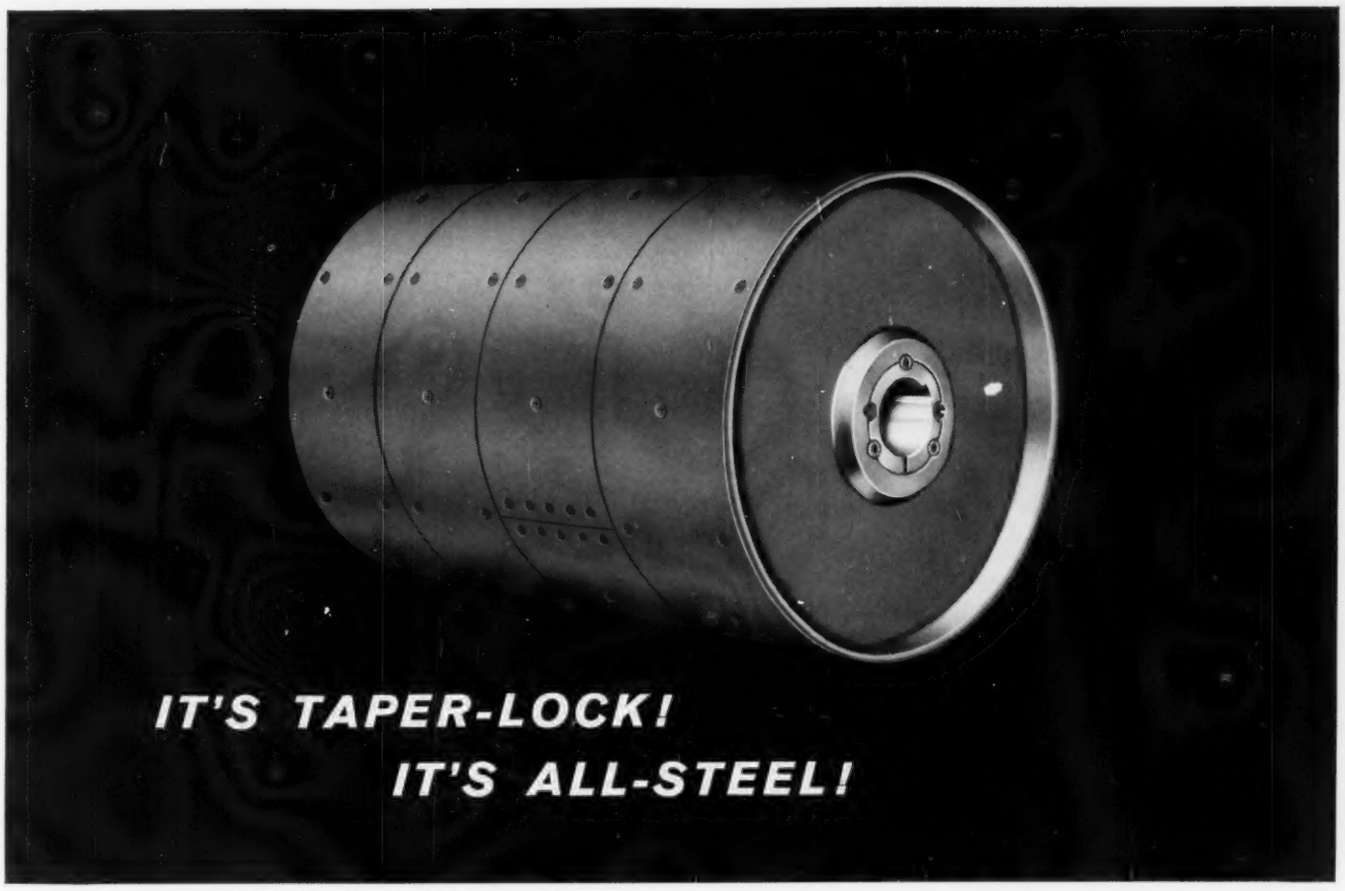
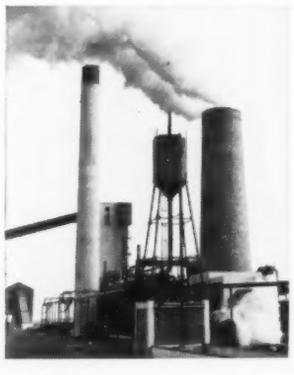


The modern Conveyor Pulley for superior performance . . .



One tough application after another proves beyond doubt that you can't beat a lagged, Taper-Lock Steel Conveyor Pulley for the hard jobs! Here is the score on their use in rugged coke plant service. In this particular case the installation was on belts from the quencher and loading belts to cars. The report was made after *three years of use.*

1. **One-third saving on initial cost.**
2. **Saving on maintenance; no redressing of pulley faces.**
3. **No appreciable wear on lagging.**

In addition, these Taper-Lock Steel Conveyor Pulleys provide the further benefits which are inherent in their design:

1. **No bolts to shear.**
2. **Easy on — easy off.**

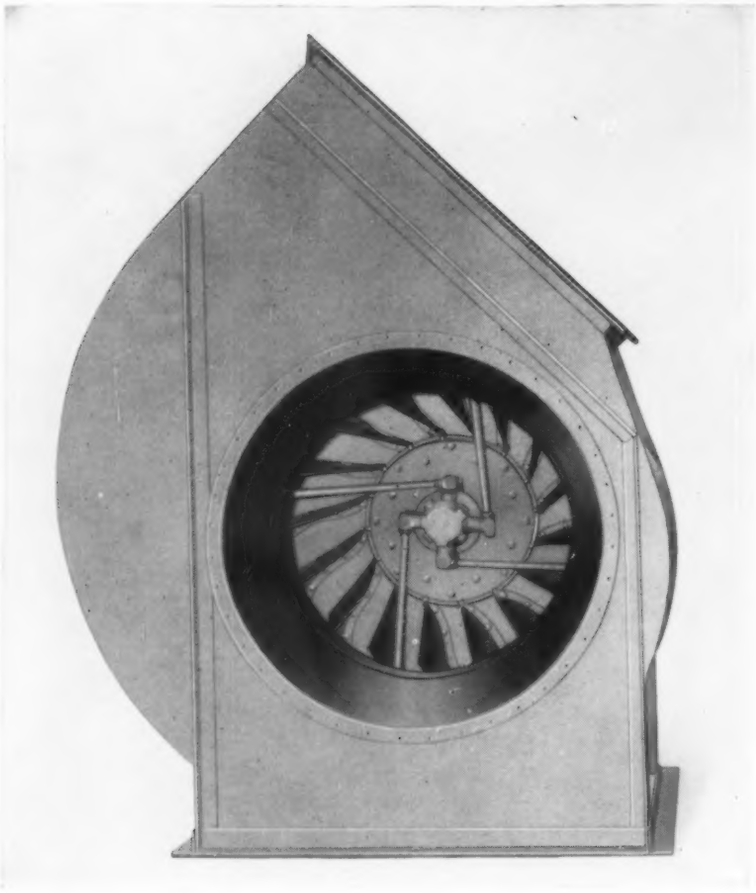
Taper-Lock Steel Conveyor Pulleys have terrific impact capability. All welds are made by the submerged arc process for 100% strength. Taper-Lock's patented back-up bar permits a weld of the full rim thickness to give 100% penetration. And there are no bolts to give way!

Normally available from stock in all face widths and diameters from 6 inches to 8 feet. *Write for bulletin.*

DODGE MANUFACTURING CORPORATION, 5900 Union St., Mishawaka, Ind.

CALL THE TRANSMISSIONEER your local Dodge Distributor. Factory trained by Dodge he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

DODGE
of Mishawaka, Ind.



CORROSIVE GASES HANDLED WITH LESS MAINTENANCE LESS DOWNTIME

"BUFFALO" RUBBER-LINED FANS

● Longer Fan Life — Proved in hundreds of installations over a period of more than 30 years, actual records show that up to 12 times the life of ordinary metal fans may be expected from "Buffalo" Rubber-Lined Fans in severe corrosive fume service. Thus you will spend very little time maintaining the "Buffalo" equipped system in your plant.

● Economies effected in the reduction of downtime are equally impressive. The overall savings of longer life plus decreased downtime pay the slight additional cost of rubber lining many times over. A fact executive management can readily appreciate.

The "Buffalo" method of rubber-lining assures permanence. The rubber is actually "welded" into the pores of the metal with a union that is practically integral. With the "Buffalo" Rubber-Lined Fan, corrosive fumes cannot touch metal — the inside of housing, rotor and shaft are completely rubber-protected.

Whatever your corrosive fume handling problem, your nearby "Buffalo" Engineering Representative will recommend the type of "Buffalo" Rubber-Lined Fan best suited to your requirements. Contact him, or write us for Bulletin 2424-F.

OTHER SPECIAL "BUFFALO" FANS FOR SPECIAL CONDITIONS — If you have a special air or materials handling job involving severe conditions ranging from corrosive fumes to abrasive dust, investigate "Buffalo" Resin-Bonded Fiber Glass Fans . . . Industrial Exhausters . . . Volume Fans . . . Pressure Blowers and Centrifugal Exhausters . . . Electric Blowers and Exhausters.

Every "Buffalo" product features the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY
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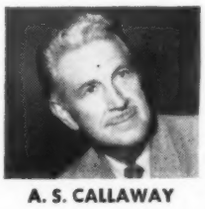
"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

These mill motors ate up brushes 'til the NATIONAL brush man stepped in!



A. S. CALLAWAY

The mill motors in this eastern steel mill were extra hard on brushes says "National" Carbon Brush Man, A. S. Callaway.

An unavoidable contaminant seemed to eat up every brush tried by the mill. Only one brush proved capable of withstanding this condition: "National" Brush Grade N-6. Naturally, the N-6, with its ability to withstand contaminants, is standard on these mill motors.

"Cal" Callaway and his fellow "National" Carbon Brush Men have been helping plants solve brush problems for years. Their experience and training–backed by National Carbon's *long term brush development*–make them top consultants on any brush problem.

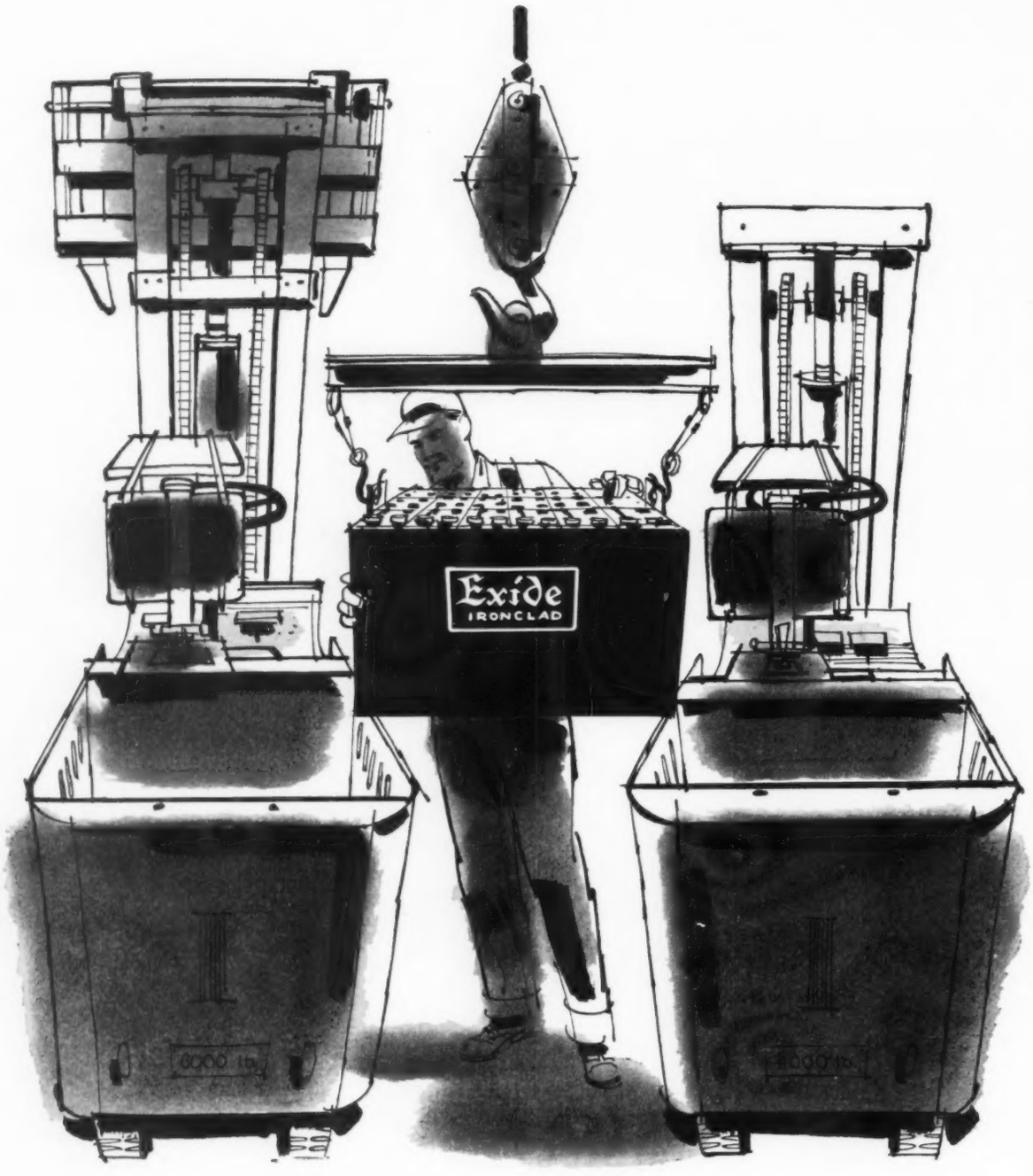
Call your "National" Brush Man today. Or write National Carbon Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y.

UNION CARBIDE

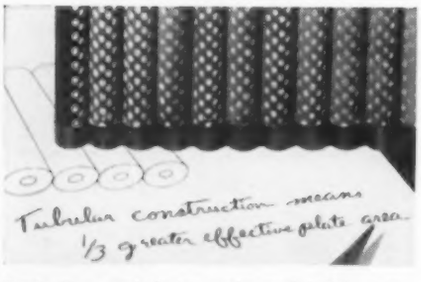
"National", "N" and Shield Device, and "Union Carbide" are registered trade-marks of Union Carbide Corporation

NATIONAL CARBON COMPANY • Division of Union Carbide Corporation • 30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. *In Canada:* Union Carbide Canada Limited, Toronto.



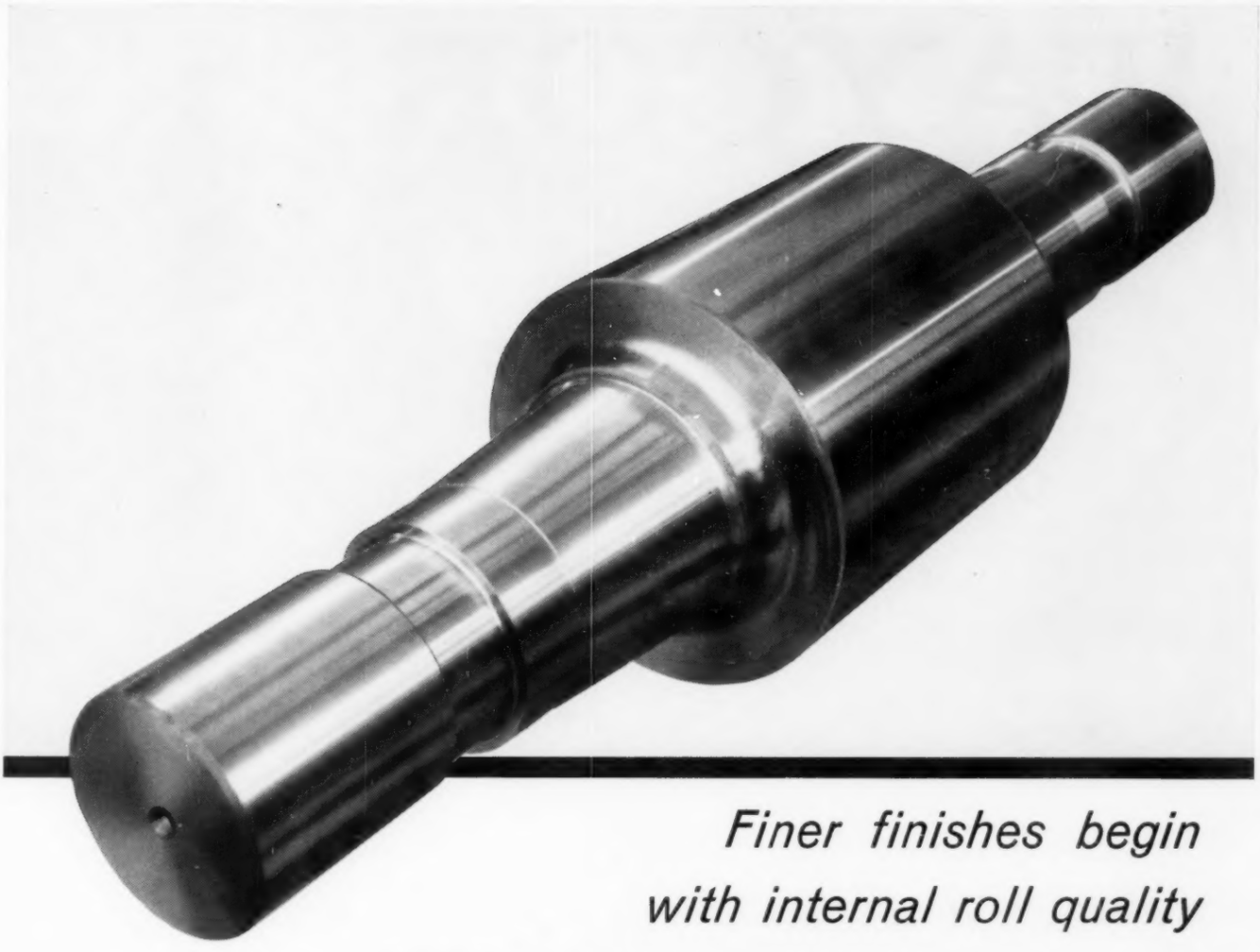
Standardization . . . interchangeability . . . versatility
Made possible by new Exide-Ironclad Battery



Here's the secret. Unique advanced tubular construction. Every positive plate packs more power. So you get greater battery efficiency—a more compact battery for a given capacity rating.

It packs more power—up to 44% more than batteries you may be using now. But the dimensions are the same. Buy a new, more powerful Exide-Ironclad Battery for a small truck, and you boost its work capacity. Use the same battery to provide normal power for many bigger trucks. Yet it costs you less. Only Exide-Ironclad Batteries give you this extra versatility, interchangeability and extra economy—plus higher power and even longer iife potential. Now more than ever, Exide-Ironclad Batteries are your best buy. For details, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pa.

Exide®



Finer finishes begin with internal roll quality

SPECIFY **BIRDSBORO** ROLLS

B

• The "how" of Birdsboro roll internal quality and surface strength, which result in finer finishes, is available to you now . . . along with details on the results you can expect. Contact your Birdsboro roll specialist. *Main Office, Engineering Department and Plant:* Birdsboro, Pa., *District Office:* Pittsburgh, Pa.

BIRDSBORO
STEEL FOUNDRY AND MACHINE CO.

STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • STEEL CASTINGS • Weldments "CAST-WELD" Design • ROLLS: Steel, Alloy Iron, Alloy Steel

TAYCOR

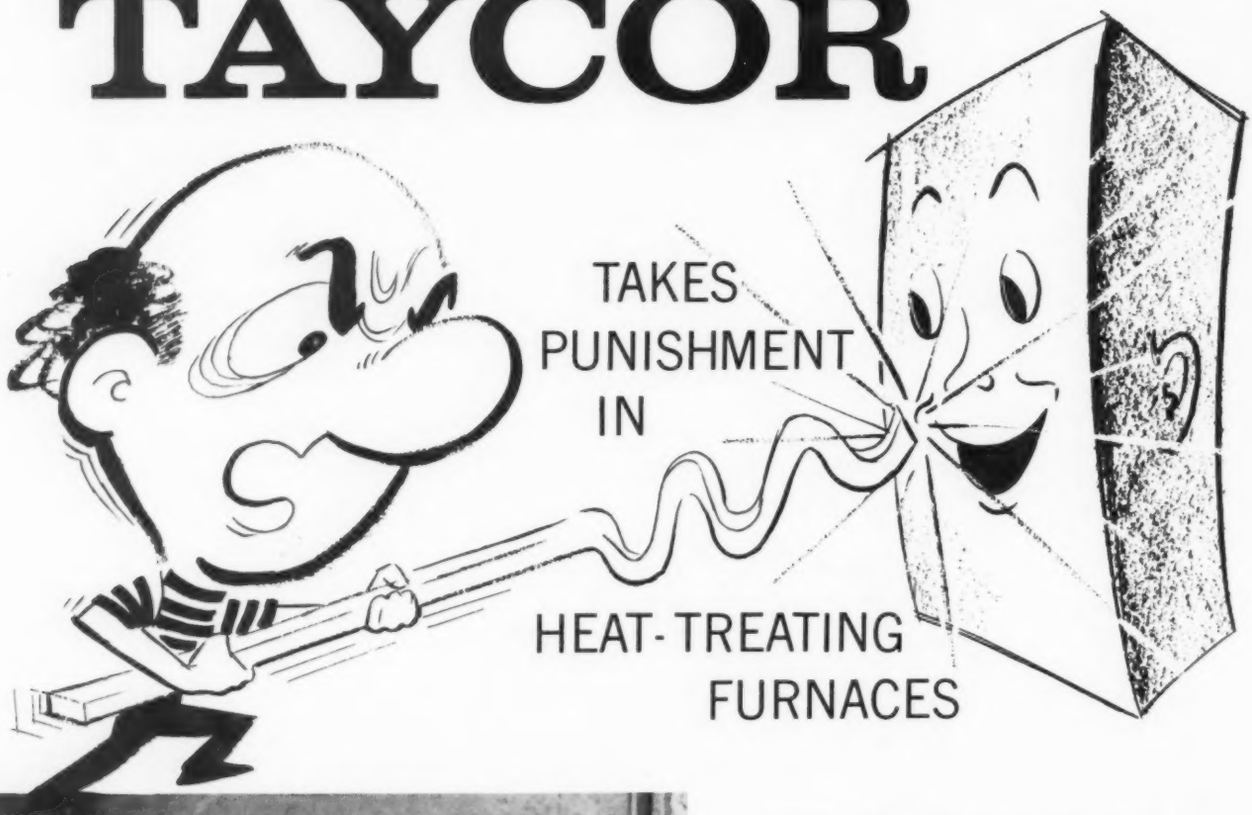


Photo shows solid hearth and side muffles of a standard under-fired heat-treating furnace. Both hearth and piers are built of TAYCOR brick. When this photo was taken the TAYCOR had been in service 14 months, with little sign of wear.

TAYCOR (corundum-base) refractories give outstanding service in hearths of under-fired heat-treating furnaces. One mid-western company uses this type of furnace for annealing, normalizing, and pack-carburizing gear blanks and other machinery components weighing up to 600 lbs. Until TAYCOR was installed, this company had constant trouble with abrasion of the furnace hearth. Now, after 14 months of severe service, their TAYCOR hearth is still in excellent condition.

Why not test TAYCOR—the refractory with exceptional resistance to abrasion *and* iron oxide attack—in your furnaces?

Exclusive Agents in Canada:
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TAYLOR ZIRCON · TAYLOR SILLIMANITE

The **CHAS. TAYLOR SONS Co.**
A SUBSIDIARY OF NATIONAL LEAD COMPANY
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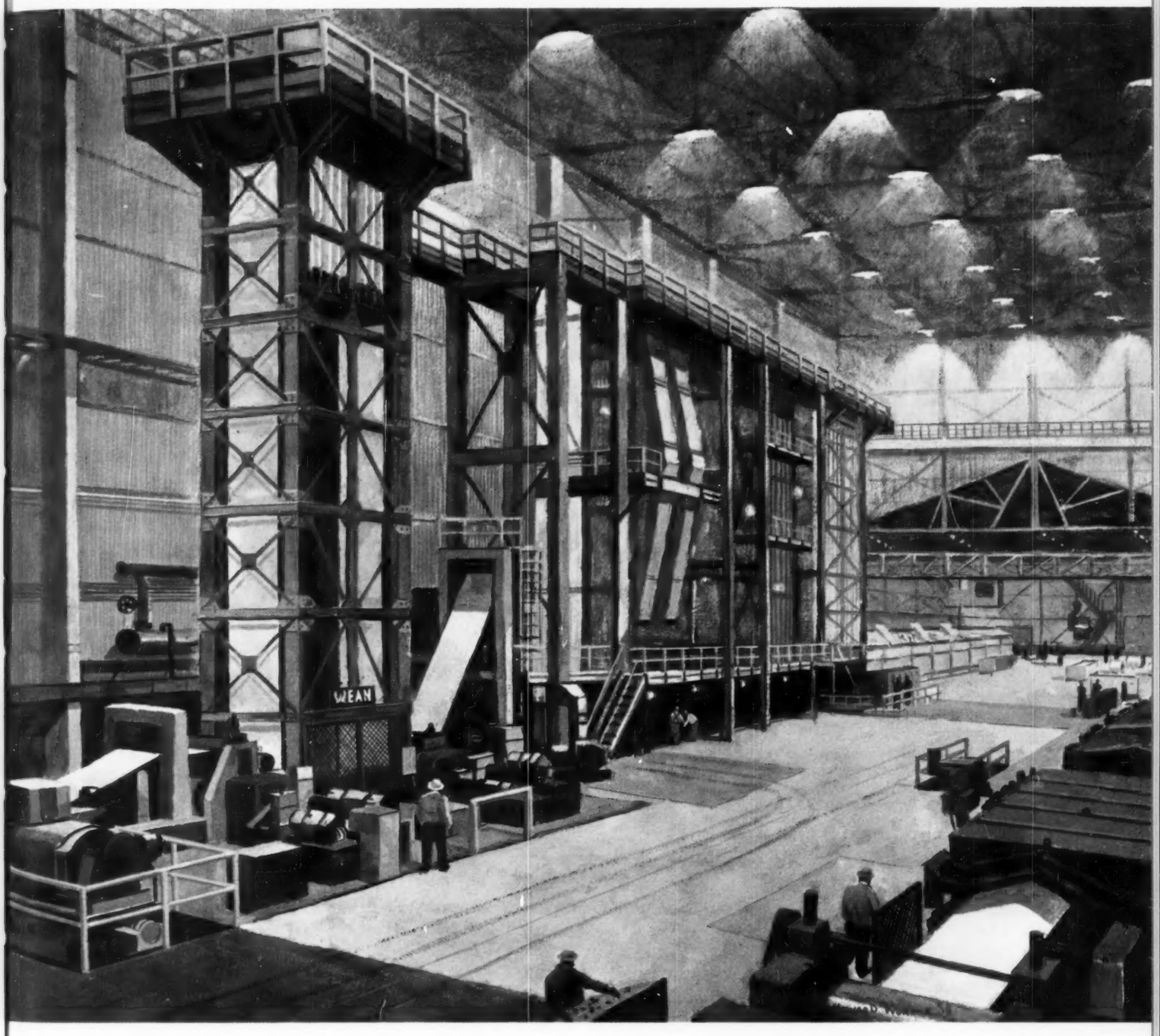
REFRACTORIES SINCE 1864 • CINCINNATI • OHIO • U. S. A.

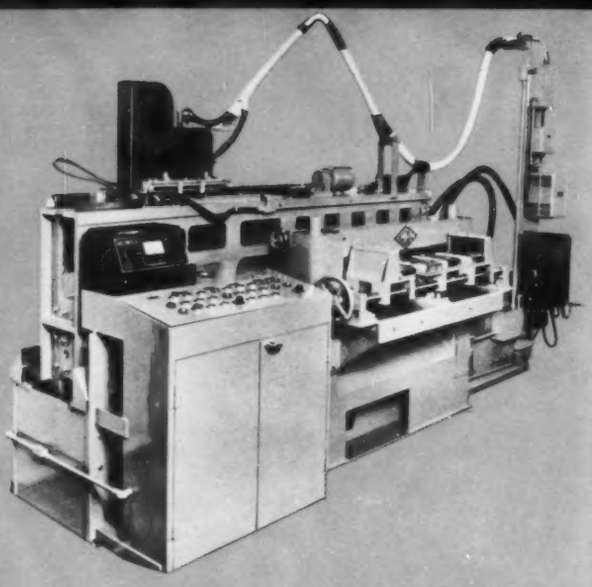
Wean, "Youngstown" and Annealing...



The dynamic steel industry has spearheaded our industrial growth by a continuing interest in tomorrow's progress as well as today's product. The continuous strip annealing process is typical of this constant search for better products and improved methods of making them. Long recognized as a pioneer in the development of the continuous line process, it was only natural that Wean was one of the leaders in the development of continuous strip annealing.

THE WEAN ENGINEERING COMPANY INC. • WARREN • OHIO

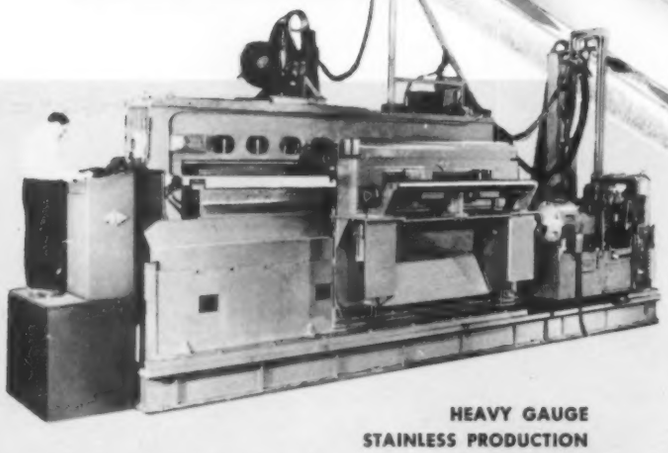
THE NEW MPM Shear Welder



CONTINUOUS SILICON SHEET PRODUCTION

Shearwelder for coil build up line for 42" wide Silicon Steel from .015" to .030" thick.

.....more automation for even faster Steel Production!



HEAVY GAUGE STAINLESS PRODUCTION

Shearwelder for butt welding 60" wide x .250" thick Stainless Steel.

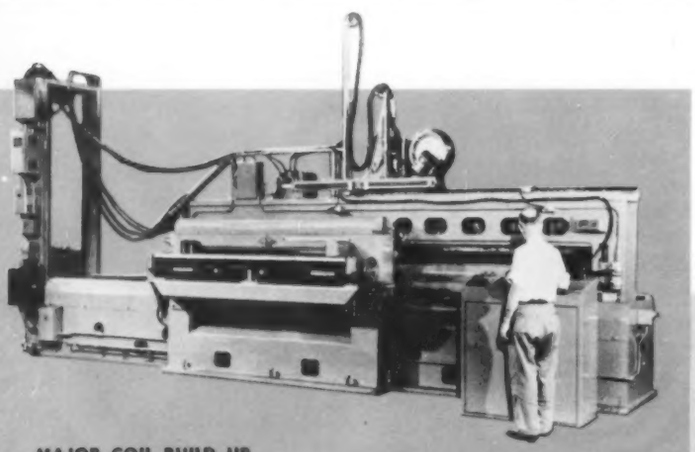
● Metal Processing Machine Company's new Shearwelders are outstanding because of their advanced design incorporating automatically sequenced operations.

Shearing and welding are performed at the same station with positive clamping right at the work area, thereby insuring perfectly aligned butt welds.

"M.P.M." welds are **extremely ductile**, permitting subsequent rolling, forming, or blanking operations. Weld joints are smooth and require **no trimming**.

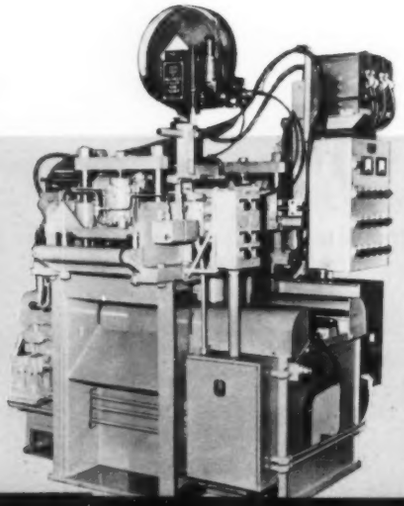
Rugged construction is insurance for minimum maintenance and compact design saves floor space.

THE METAL PROCESSING MACHINE CO.
SUBSIDIARY OF THE McKAY MACHINE CO.
YOUNGSTOWN, OHIO



MAJOR COIL BUILD UP

Shearwelder for Carbon Steel coil build up line for .015" to .060" thick x 72" maximum width.



McK MPM

CONTINUOUS TUBE MILL PRODUCTION

Shearwelder used with strip looping device for splicing coil to coil to permit continuous production of tube mill.

10065

PROOF: B&W Refractories withstand CO and H_2 prepared atmospheres

ATMOSPHERE	APPLICATION	CONSTRUCTION	RESULTS
60% CO	Pusher Type Malleabilizing Furnace	Walls lined with B&W K-23 Insulating Firebrick backed with B&W K-20 IFB. Roof construction—9′-0″ wide sprung arch of B&W K-23 IFB.	No major rebuilding in 21 years.
40% CO	Radiant Tube Annealing Furnaces Malleable Iron Company	Bases lined with 7″ Kaocrete-A, backed with 6″ Kaolite-20. Base size—21′-9¾″ x 9′-9¼″. Temperature 1550 to 1600 F.	In service 11 years. Reducing atmosphere has no effect on the base. All portable annealing furnace bases in plant lined with B&W castables. *Maintenance costs reduced greatly.*
		Bell type covers lined with 9″ B&W K-23 IFB standard shapes in the arch, side and end walls. 13½″ K-23, with Kaowool, is used around the radiant tube openings. Cover is 22′-6″ x 10′-5½″ outside x 8′-4½″ to top of arch.	After approximately 6 years of service, lining showed no disintegration from reducing atmosphere.
65% CO	Radiant Tube Annealing Furnace	Base lined with 5½″ Kaocrete-A and 3½″ Kaolite-20 on top of 5½″ of block insulation. Base size 21′-9″ x 9′-9″. Temperature 1700 F.	Formerly heavy firebrick linings required rebuilding yearly. B&W castable construction has given more than 9 years' service. Customer standardized on B&W castables.
100% N_2 and 100% H_2	Elevator Type Annealing Furnaces Large Steel Co.	Walls lined with 9″ B&W K-23 IFB plus 3″ K-20 IFB. Furnace size 6′-0″ x 16′-0″ x 4′-0″. Temperatures in excess of 2100 F.	B&W refractories show no sign of deterioration in six furnaces of this type in 3 years' operation. Barring mechanical damage, refractories should give long additional service.
100% H_2	Rectangular Hood Type Annealing Furnaces	60 Furnaces, 24 have wall construction consisting of 18″ B&W K-26 IFB plus 2½″ K-1620 IFB. 36 units use wall of 9″ B&W K-26 IFB plus 5″ K-1620 IFB. Furnace size—12′-0″ x 8′-6″. Temperature 2150 F.	Of the 60 covers in service only 2 were rebuilt after 2 years' service. Plant masonry superintendent reports no shrinkage; estimates 15 years' additional life if not for mechanical abuse.

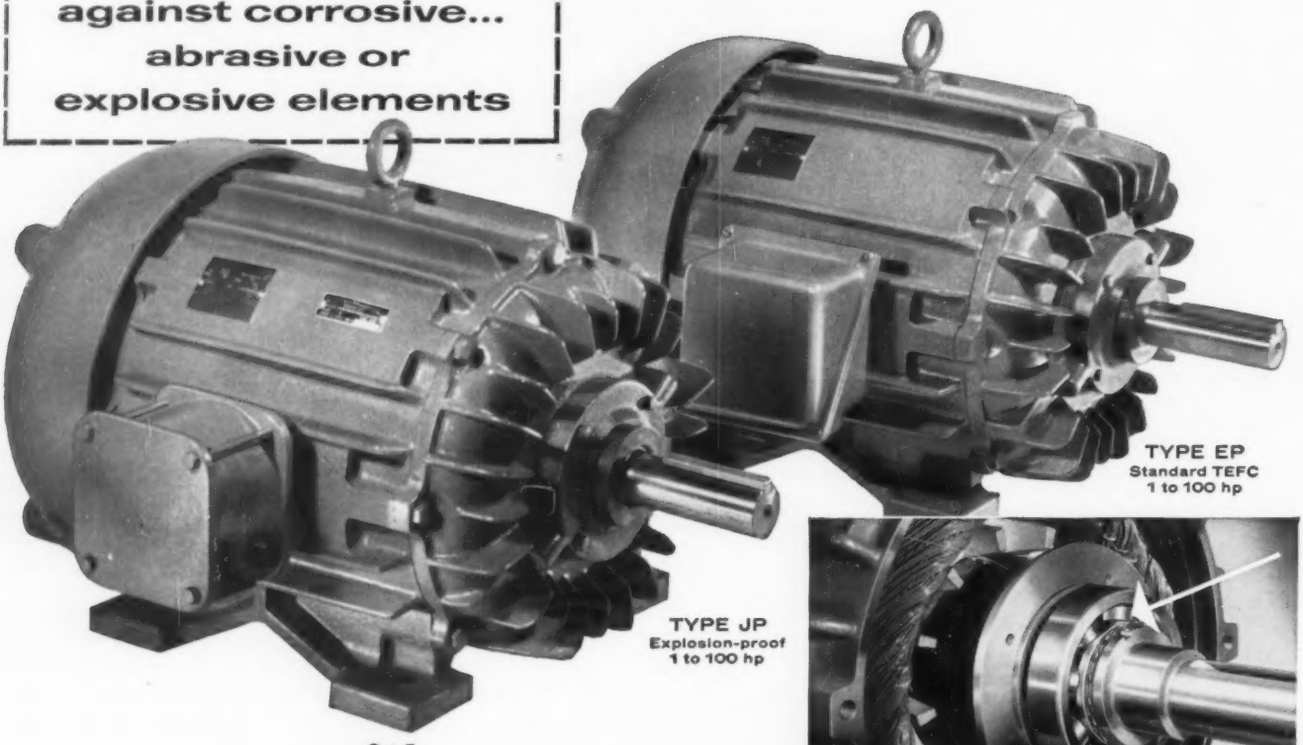
Consult your B&W Refractories Representative for helpful information on your prepared atmosphere problem.

B&W REFRACTORIES PRODUCTS: B&W Alimul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide • B&W Ramming Mixes • B&W Kaowool

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

YOU GET
EXTRA PROTECTION
against corrosive... abrasive or explosive elements



TYPE EP
Standard TEFC
1 to 100 hp

TYPE JP
Explosion-proof
1 to 100 hp

with

Wagner totally enclosed motors... protected for longer motor life

If you need motors that will keep production rates up . . . that will give the continuity of service that is so important to automation . . . that will operate with complete dependability under the most severe conditions—Wagner totally-enclosed motors are your soundest choice.

Type EP Motors offer protection against corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well—designed and approved for use in explosive atmospheres.

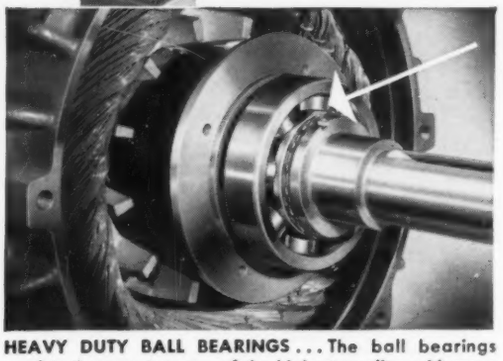
NEW NEMA FRAMES . . . These motors are built in the new NEMA Frame sizes from 182 through 445U, with ribs that add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life. Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs and continuity of operation.

1 TO 100 HP—4 POLE, 60 CYCLE—
NEMA FRAMES 182 THROUGH 445U

Wagner Electric Corporation
6483 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U. S. A.

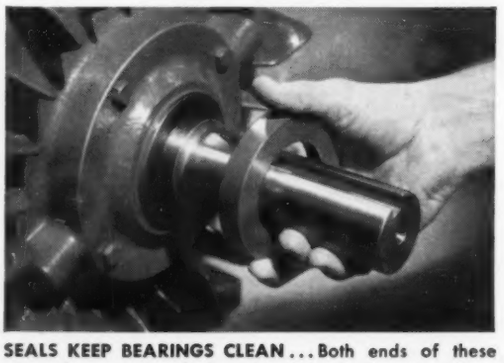
WM58-5

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES



HEAVY DUTY BALL BEARINGS . . . The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long troublefree service under heavy loads.

BEARINGS CAN BE RELUBRICATED . . . Factory installation will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.



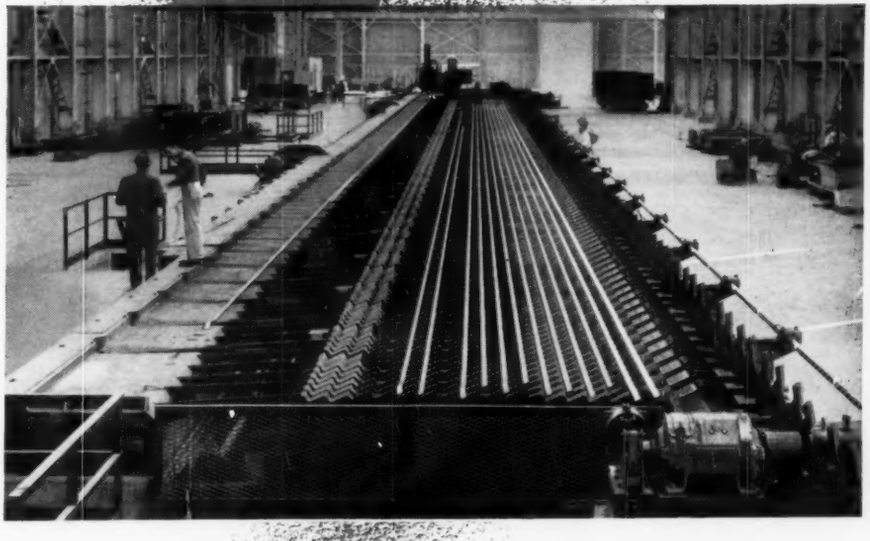
SEALS KEEP BEARINGS CLEAN . . . Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.

MORGAN MILLS
MORGAN QUALITY

from START to FINISH

MERCHANT AND ROD MILL
Atlantic Steel Company
Atlanta, Georgia

Morgan engineered and equipped from charging car to cooling bed this new Atlantic Steel Mill is now in full operation. This mill is just one of two hundred and twenty-one Morgan continuous rolling mills which have been purchased by steel plants throughout the world.



MORGAN
WORCESTER

MORGAN CONSTRUCTION CO., Worcester, Massachusetts

Rolling Mills • Morgoil Bearings • Wire Mills • Regenerative Furnace Control • Ejectors • Gas Producers

WHERE DO NEW IDEAS COME FROM? . . .

ideas that stand the test of time spring from the minds of men with the courage to lead — to pioneer in thought — to try the untried.

It was an idea such as these . . . a revolutionary new product . . . that brought Wheelabrator Corporation into being fifty years ago. And the intervening years record a steady procession of other successful developments . . . *firsts* in their field.

This pioneering, inventive spirit has permeated the organization since the early days of its founding. It is the heart of Wheelabrator's business philosophy . . . the reason for its growth and leadership.

Preserving this proud tradition is a constant challenge and a never-ending responsibility of the entire Wheelabrator family of pioneers.

they come from **WHEELABRATOR**®

In airless blast cleaning, the *new* ideas of today come from the perfecter of the process itself — Wheelabrator Corporation. Since its invention twenty-five years ago, the Wheelabrator has opened up a vast world of uses in many fields. Its history is one of challenges met and needs fulfilled.

In the steel industry, for example, Wheelabrator's preeminence stems from more than a decade of pioneering leadership . . . in developing the *first* machines and methods for utilizing the airless blast process for finishing mill rolls and descaling sheet and strip, slabs and billets, structural shapes, wire rod and bar stock.

Added to these accomplishments is the fact that Wheelabrator's background includes the most varied and extensive experience, by far, from the standpoint of successfully operating installations . . . 132 machines in 103 plants.

Sensing problems . . . finding practical ways to solve them . . . pursuing the policy of progress through creative engineering . . . that's why the new ideas in blast cleaning come from Wheelabrator. And a good policy it is — for the next fifty years, too.

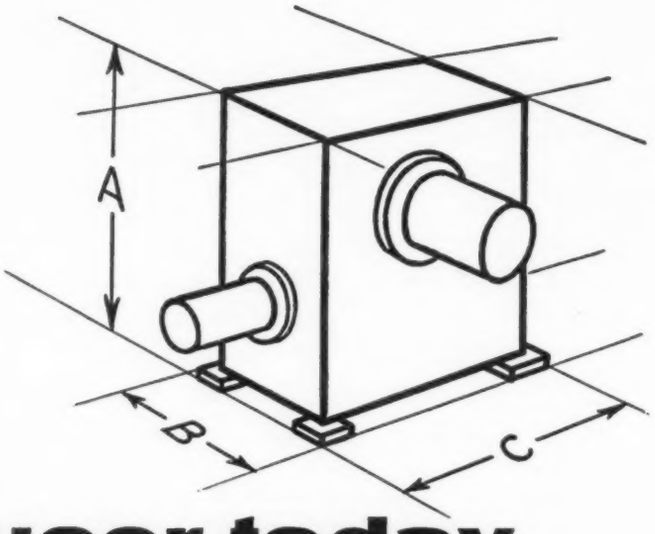
WHEELABRATOR corporation

396 S. Byrkit Street Mishawaka, Indiana

Canadian Offices: Scarborough (Toronto) Montreal

World's largest manufacturers of airless blast equipment and steel abrasives.

Do-It-Yourself...



Let's design a speed reducer today

So you can't find a speed reducer to fit your latest brainchild without ruining the design? Doggone manufacturers all build reducers too big to fit into those few cubic feet you've got left for the reduction unit back behind the double-ended dingbat?

Revolt! Design your own! Show 'em!

By George, design it yourself and it'll fit. How? Well, you know your size limits. Draw the biggest box that'll fit the space and you've got your reducer housing specifications.

Now you need gears that will (1) transmit the needed horsepower under all operating conditions, (2) provide the ratio your machine requires and (3) fit the space that's available. You'll soon discover that there are limits to what gears can do in transmitting horsepower. The cheapest answer is parallel shaft helical gears. If they'll fit you're in clover. But they take the most room, especially when you're out of the fractional hp range. The right angle worm and gear combination is the most compact drive arrangement.

Here again you have a choice. Cylindrical worm gearing is often used, and if it'll do the job, is worth consideration. But it's not the most compact possibility. The best way to shrink gears and still carry the load is the double-enveloping worm gear design. Both worm and gear are throated and the two literally wrap around each other. This brings center distance of the two shafts closer together and you can put them inside smaller housings.

Does this reduce load capacity? No sir! You can carry the same load with center distances up to 33% smaller than those of cylindrical worm gears. Or use the same center distance and carry a greater load. Will these gears hold up in operation? Sure, if you beef up the teeth, the bearings and the housing. Use straight-sided worm and gear teeth and you'll get all the strength there you'll ever need. Use large taper roller bearings with real B-10 life. Use a reinforced, heavy wall housing that won't distort under load. Put fins on it for added cooling and increased thermal horsepower capacity to meet your needs. Now, put the whole thing together and you've got a speed reducer that's a dilly.

Designing your own speed reducer give you a headache? Looking for an easier way? There is one. Someone's already done exactly what you're talking about. You can order that compact speed reducer right off the shelf. Where?

Cone-Drive Gears, that's where!

Yes sir. They stock double-enveloping worm gear speed reducers from fractional to 665 hp. Standard ratios from 5:1 to 70:1 in about 15 increments, all interchangeable in any type housing of a given center distance. Worms over and worms under. Gear shafts vertical, too. Single- or double-extended output shafts, or shaft mounted. Over 200,000 combinations possible. Wow! Just about anything you want.

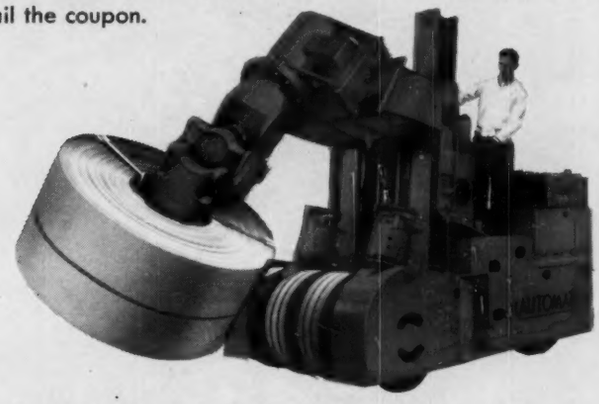
Better get Cone-Drive's new speed reducer catalog that details everything. Ask for Bulletin CD-218. Cone-Drive Gears, Div. Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

BEST OF THE HEAVIES...

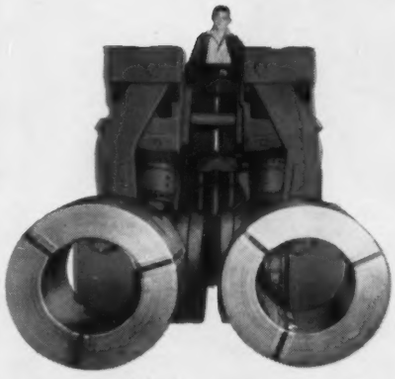
SERIES MF-ELBOLIFT: Works on leverage principle new to lift truck design... eliminates entire mast assembly. Carrying a load of 15,000 lbs., the Elbolift passes easily through any 78" boxcar door... will right-angle stack a 52" long load up to 120" high comfortably in a 13' 8" aisle. CAPACITIES: 12,000 to 20,000 pounds.

Automatic...
Most Complete Line of Steel and Die Handling Equipment
Capacities up to 110,000 lbs. or more

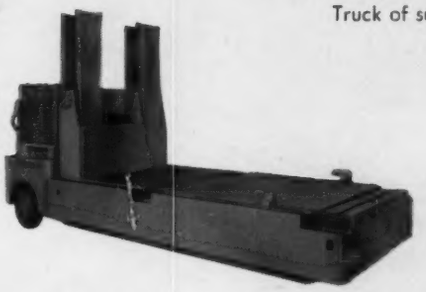
In the heavyweight division of materials handling, no other line matches the versatility and range of Automatic's heavy duty trucks. This is the direct result of many years of specialized engineering and manufacturing experience in the coil and die handling field. The five examples shown here comprise only a small sampling of the wide range of heavy duty handling requirements served by Automatic equipment. So don't hesitate to call us in on any problem involving weights up to any practical limit. No obligation, of course. Just mail the coupon.



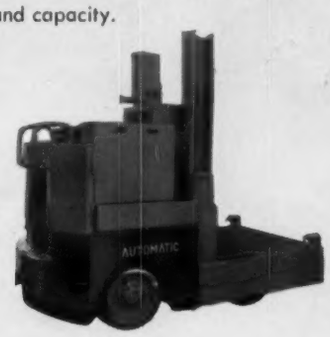
COIL-UPENDER ATTACHMENT: Picks up coil in vertical position and rotates to horizontal or vice versa. Holds coil securely throughout rotation... prevents telescoping. Handles up to 60,000 lbs. Now available on Automatic HR Series or as an attachment for any Automatic Truck of suitable design and capacity.



SKYLIFT GIANT: Heavy duty mast type truck available with either forks or ram. Model shown here has split ram to handle either 1 or 2 coils at a time. CAPACITIES: 20,000 through 80,000 pounds or more.



SERIES TLO: First heavy duty die handlers ever made with completely hydraulic loading, unloading and lift. Bullards move much faster and smoother than in any mechanical system... unloads at end or either side to meet any requirements of space and accessibility. CAPACITIES: 4,000 to 110,000 pounds or more.



MODEL TLO-10: Shortest, most compact 20,000 pound die-handler made... fastest, easiest to maneuver, especially in narrow aisles. Hydraulically operated lift, loading and unloading.

Automatic Electric Industrial Trucks Cost Less to Own... Less to Operate

AUTOMATIC TRANSPORTATION COMPANY
Division of The Yale & Towne Manufacturing Company
47 West 87th Street—Dept. H8 —Chicago 20, Illinois

Electric Automatic Industrial Trucks

WORLD'S LARGEST EXCLUSIVE BUILDERS OF ELECTRIC-DRIVEN INDUSTRIAL TRUCKS

AUTOMATIC TRANSPORTATION COMPANY
Division of The Yale & Towne Manufacturing Company
47 West 87th Street, Dept. H8, Chicago 20, Illinois

☐ Please rush me complete specifications on following Automatic heavy duty equipment.

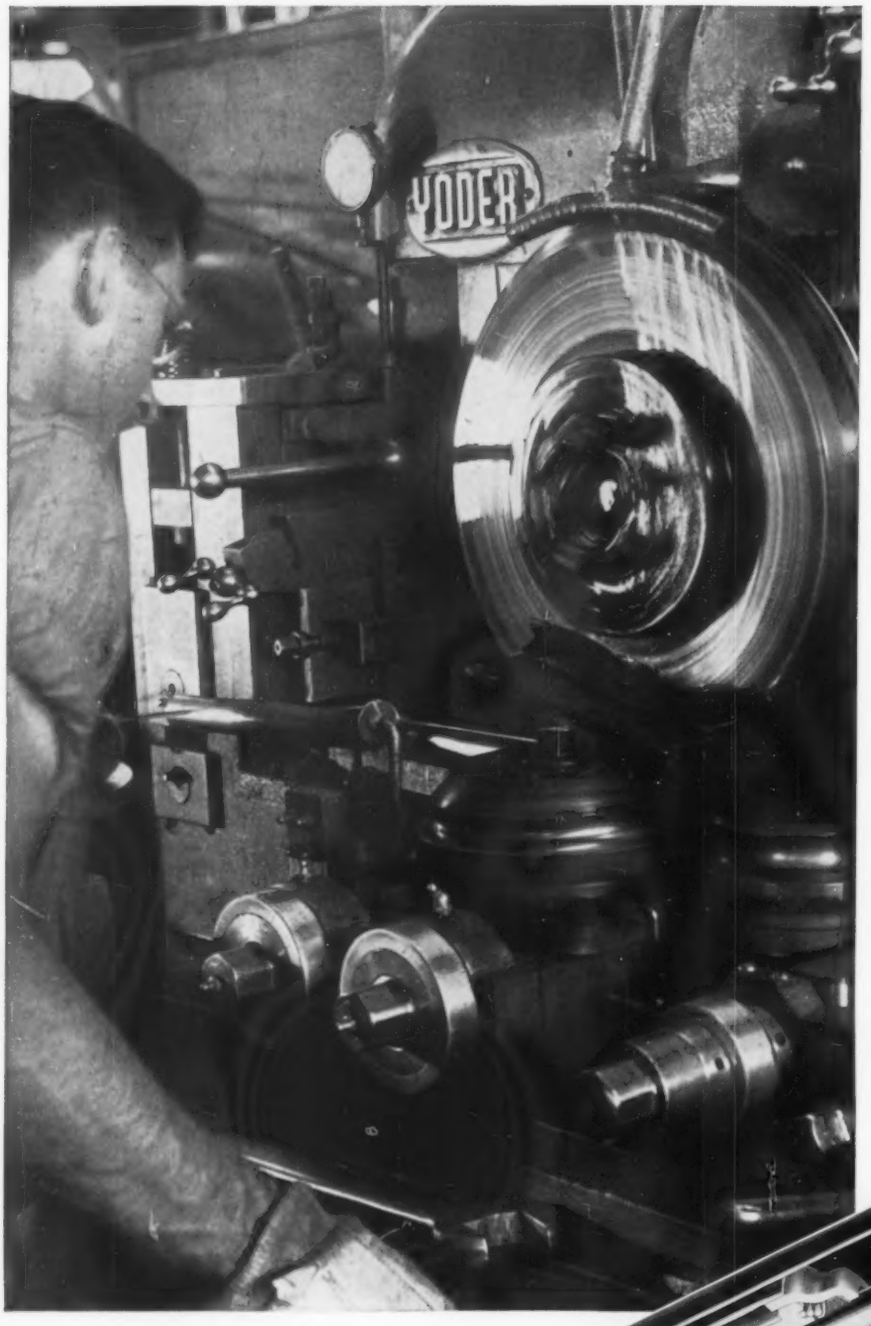
MODELS.....

Your Name.....Title.....

Firm.....

Address.....

City & Zone.....State.....



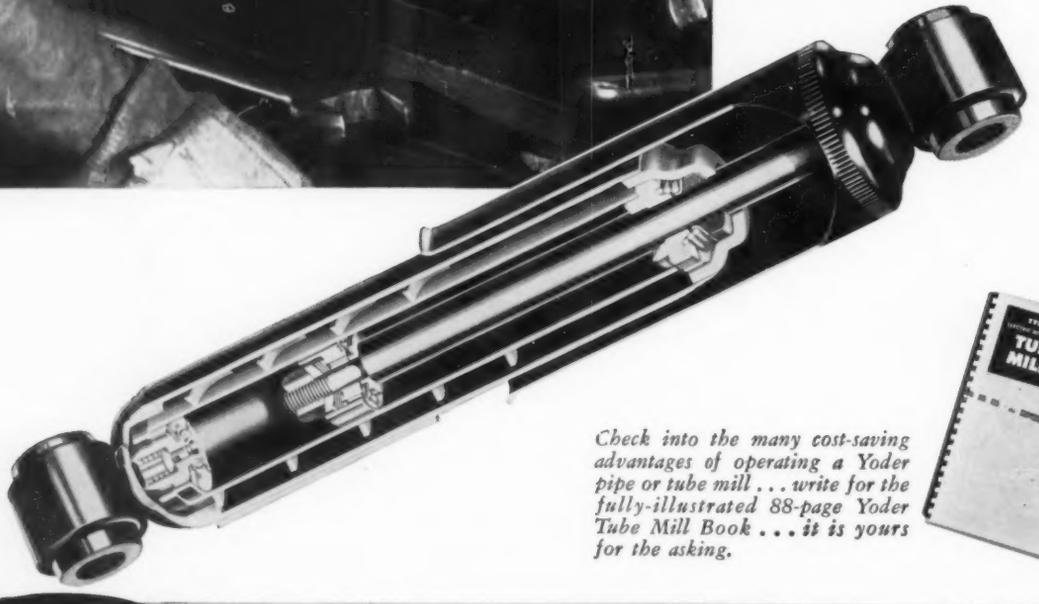
Monroe Shock Absorbers rely on performance of YODER Tube Mills!

After 15 years of continuous operation the Yoder Type-M Electric-Resistance Weld Tube Mill shown here, is still producing precision tubing for the Monroe Auto Equipment Co., Monroe, Michigan.

Yoder produced tubing is the basic component of the famous "Monro-Matic" shock absorber. Measuring 2 1/64" outside diameter (plus several other sizes) the tubing is made from 22 gauge strip in one continuous operation . . . it is automatically cold-roll formed, welded and cut to pre-determined lengths.

This typical installation of a Yoder tube mill exemplifies the accuracy, dependability and production economies of Yoder-made tubing. If your business requires pipe or tubing, ferrous or non-ferrous, in sizes from 1/4" to 26" diameters, there is a Yoder mill designed to produce it economically, efficiently and accurately.

THE YODER COMPANY
5495 Walworth Avenue • Cleveland 2, Ohio



Check into the many cost-saving advantages of operating a Yoder pipe or tube mill . . . write for the fully-illustrated 88-page Yoder Tube Mill Book . . . it is yours for the asking.

ENGINEERING **YODER** MANUFACTURING

PIPE AND TUBE MILLS (ferrous or non-ferrous)
COLD ROLL FORMING MACHINES
ROTARY SLITTING LINES

ALCOA HAS THE RIGHT COMBINATION

For 15 years, Alcoa has lived with leading engine and equipment builders and bearing manufacturers to solve their bearing problems. From this experience, we learned that the ideal bearing material can't excel in one way and fail in another. For example, a bearing material must be hard enough to withstand wear, yet soft enough to embed; strong enough to carry heavy loads, yet ductile enough to conform. In short, the best bearing material must have the right combination of features to meet demands from many directions.

We were certain from the start that aluminum, because of its inherent properties, must hold the answer, and so we

launched a long series of tests. After more than 400 different aluminum alloys had been tried, we found the ones we wanted: the aluminum alloys with the right combination of advantages. These Alcoa® Aluminum bearing alloys are now used in solid cast aluminum bearings that:

Withstand Heavy Loads . . . up to 10,000 psi on projected area.

Run Cooler . . . Because aluminum is the best heat conductor among bearing materials, aluminum bearings run cooler . . . as much as 20° by actual test.

Conform Readily . . . Aluminum has good ductility, conforms readily to misaligned shafts and nonparallel pins to reduce unit loading, extend bearing life.

Have Ideal Embeddability . . . Aluminum embeds dirt particles better than bronze, but not as deeply as babbitt; particles roll out easily and are trapped by filters.

Resist Corrosion . . . Aluminum bearings are unaffected by corrosive additives in oils and need no protective coatings.

Offer Design Flexibility . . . Aluminum's combination of structural properties allows great flexibility in design.

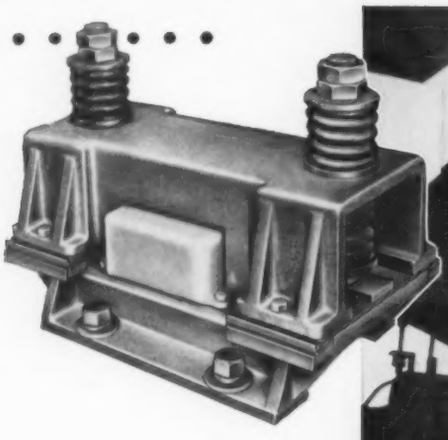
Why not have the right combination of features working for you in all your bearing requirements? Call your nearest Alcoa sales office for further information. Or, write Aluminum Company of America, 1983-F Alcoa Building, Pittsburgh 19, Pennsylvania.

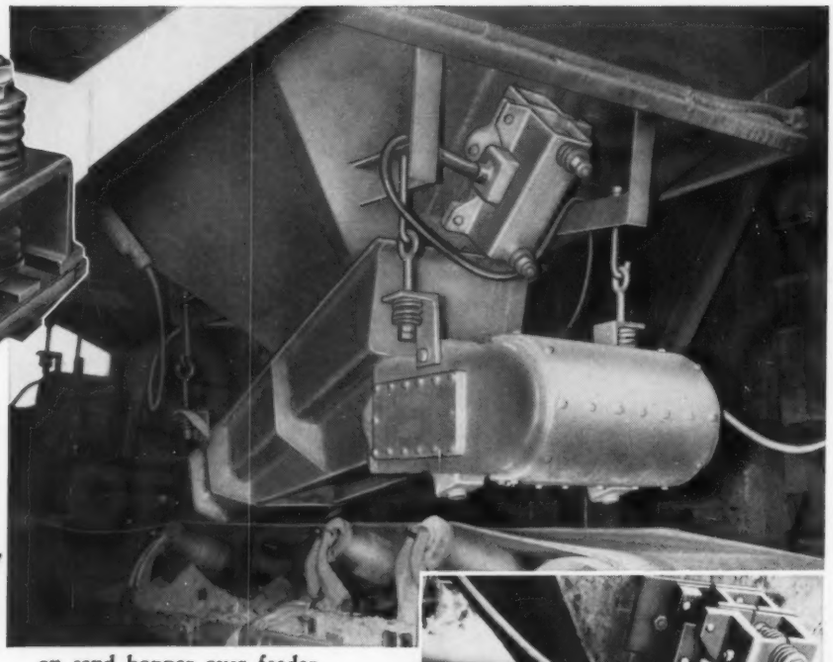
ALCOA ALUMINUM BEARINGS

Your Guide to the Best in Aluminum Value

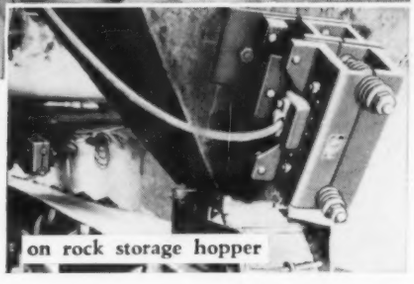
"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings

Eliminate sticking, arching, plugging of bins, hoppers and chutes--Keep them flowing freely with . . . . . .





on sand hopper over feeder



on rock storage hopper

SYNTRON

Pulsating Magnet
BIN VIBRATORS

—— designed to keep materials flowing freely through bins, hoppers and chutes — efficiently, effectively and economically.

—— help processing equipment operate at full capacity by eliminating slow downs or shut downs due to arching and plugging of materials.

—— SYNTRON Bin Vibrators set up waves of powerful, high speed, instantly controllable vibrations, 3600 per minute, that move the most stubborn materials.

SYNTRON engineered Bin Vibrators offer these advantages for low cost operation — versatility, dependability, easy installation and inexpensive maintenance.

SYNTRON Bin Vibrators are built in a wide range of sizes to fill every need from a cubic foot hopper to large bins and bunkers.

Available in electromagnetic, pneumatic or hydraulic powered units.

Solve that troublesome bin problem with SYNTRON Bin Vibrators. Send details to our application engineers or check your telephone directory for the nearest SYNTRON Representative.

RP-25R

Builders of Quality Equipment for more than one third of a century.

Other SYNTRON Equipment of Proven Dependable Quality

designed to increase production, cut production costs, improve products

Vibrators (bins, hoppers, chutes)
Vibratory Feeders
Vibratory Screens
Shaker Conveyors
Vibratory Elevator Feeders
Weigh Feeders
Packers and Jolters
Hopper Feeders
Lapping Machines
Rectifiers (Silicon and Selenium)
a-c to d-c Selenium Rectifier Units
Electric Heating Panels
Electric Heating Elements
Sinuated Wires
Shaft Seals
Electric Hammers
Concrete Vibrators
Paper Joggers

Our representatives will be glad to work with you in selecting the proper equipment for your operation.

Call your nearest Syntron representative

Write for a SYNTRON Illustrated Catalog — FREE

SYNTRON COMPANY
699 Lexington Avenue Homer City, Penna.

HE CAN "MEASURE" MORE PROFIT FOR YOU. This Dowell service engineer can measure the amount of scale he removes from a line, using the Dowell method of chemical cleaning. *This removed scale and sludge can also be measured in increased profit dollars for your company.*

Example: Scale build-up in the main water supply line of a major Midwestern plant had reduced the "C" factor from 105 to 72. This situation became apparent just at the start of the peak season for the company. Management had a choice between laying an auxiliary line or trying to clean their present one. They decided to clean the line—but not the old-fashioned mechanical way. Time would not permit. Dowell was called in to do the job—chemically.

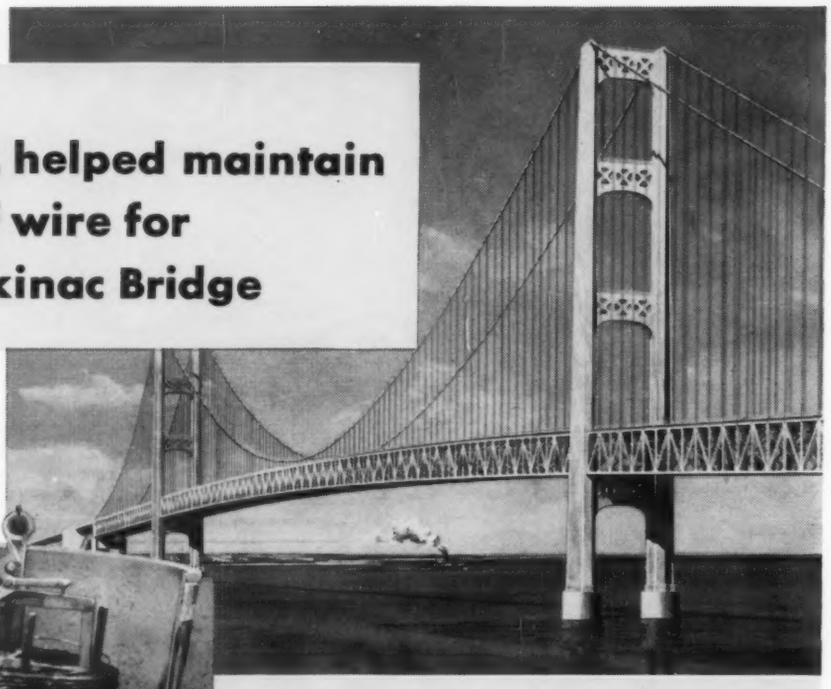
Dowell Service was fast—the job was done in three days. Dowell Service was effective—the "C" factor was increased to 92. Dowell Service was profitable for the customer—$71,000 was saved and the company's annual profit was protected.

With Dowell Service you receive the benefits of more than fifteen years experience in chemical cleaning—plus a full line of equipment, chemicals, and trained personnel. You pay one charge, get an efficient job, handled by experienced people.

Your maintenance and operating engineers probably know about Dowell Service. Ask them for the facts. Decide for yourself about the additional profit possibilities to your company with Dowell Service working for you. DOWELL—A SERVICE DIVISION OF THE DOW CHEMICAL COMPANY. Headquarters and research center, Tulsa, Oklahoma, with 165 offices and stations to serve you.

Chemical cleaning service for industry DOWELL

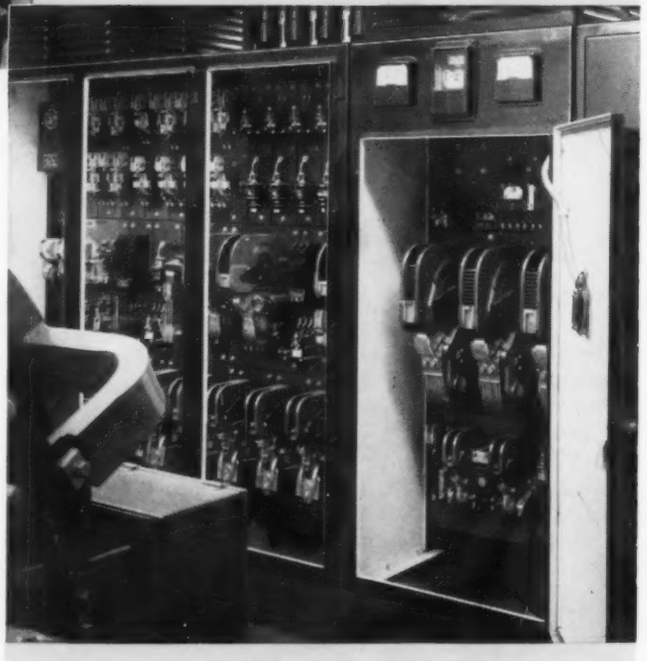
EC&M CONTROL helped maintain steady production of wire for giant cables on Mackinac Bridge



BRIDGE DRAWING • Courtesy of Dr. D. B. Steinman, Cons. Engr. INSTALLATION PHOTOS • Courtesy of American Steel & Wire Division of U. S. Steel Corporation, and Vaughn Machinery Co.

EC&M Wire block Controller *(at left)* for 60/75 HP, 500-1800 RPM, 230 Volt Motors.

Below is 725 HP, 440 Volt Synchronous Motor Starter for 500 KW Generator.



SMOOTH STARTS—QUICK STOPS

Wire drawn at speeds up to 700 feet per minute!

Recently completed Mackinac Bridge connects the two peninsulas of Michigan and stands as a great link in our national highway system. EC&M Control played an important role by helping maintain a steady flow of 0.192″ diameter wire, drawn from rods, to make up the 2-ft. diameter suspension cables.

Good wire-drawing demands several things—ability to (*1*) thread at slow speed, (*2*) accelerate smoothly to continuous drawing speed, and (*3*) provide quick-stopping when the reel is finished or a snarl develops or the wire breaks. EC&M Control for wire machines is *custom engineered* and built to the size and number of motors per machine and to the demand for ever-increasing production-speed.

Consult EC&M on wire-drawing problems.

THE ELECTRIC CONTROLLER & MFG. CO.

A DIVISION OF THE SQUARE D COMPANY

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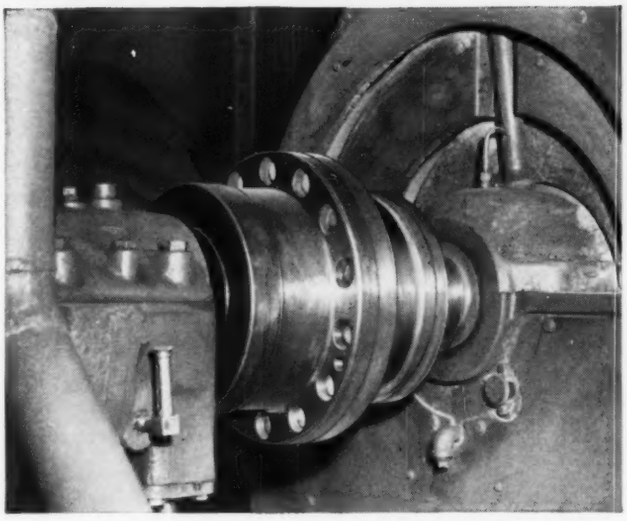
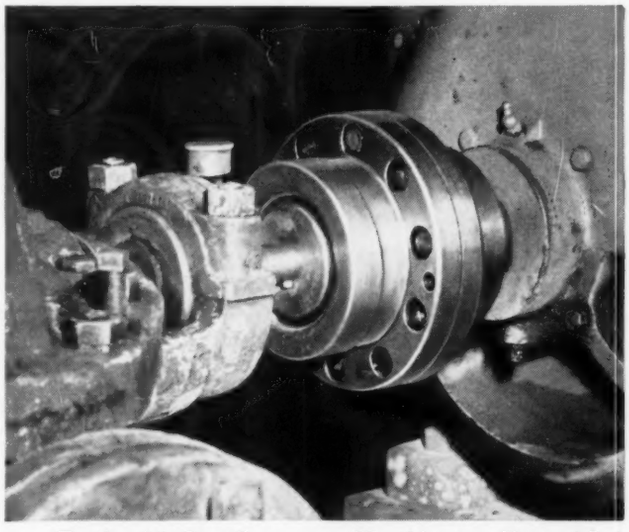
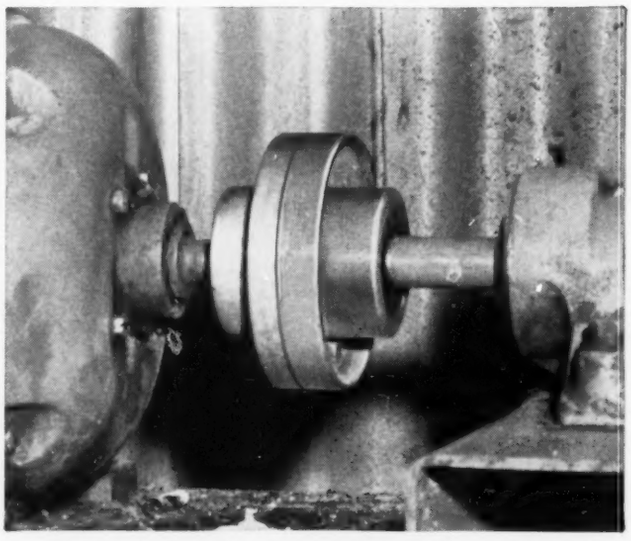


Fast's #4½ Coupling on a 1200 GPM Wilson-Snyder descaling pump. A 1500 hp., 1770 rpm motor drives the unit which operates at a head of 1250'.



Fast's #2 Coupling on a Worthington Type 4-L-1 1000 GPM pump operating at a head of 175'. Pump speed is 3570 rpm. Motor is 60 hp.



Fast's #1 Coupling on a 2500 CFM ventilating fan. Fan motor is 1½ hp. Rpm is 1800.

Detroit Steel Keeps 100 Fast's Couplings at Work with Only Minimum Maintenance

Fast's Couplings have reduced costly downtime and maintenance at Detroit Steel Corporation's Portsmouth, Ohio hot strip mill. Over 100 in number, they range in size from #1 to #20. Many of these couplings have operated with practically no maintenance for six years. Detroit Steel chose Fast's Couplings because of their *sound basic design.*

Here's why Fast's design pays off in low-cost maintenance and trouble-free performance: mechanical flexibility compensates for misalignment. Couplings last longer because there's no metal-to-metal wear. Positive lubrication forms a film on load-carrying surfaces. Metal-to-metal seal keeps out dirt, grit and moisture.

For more details, write to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3006, Scott St., Baltimore 3, Md.

THE ORIGINAL

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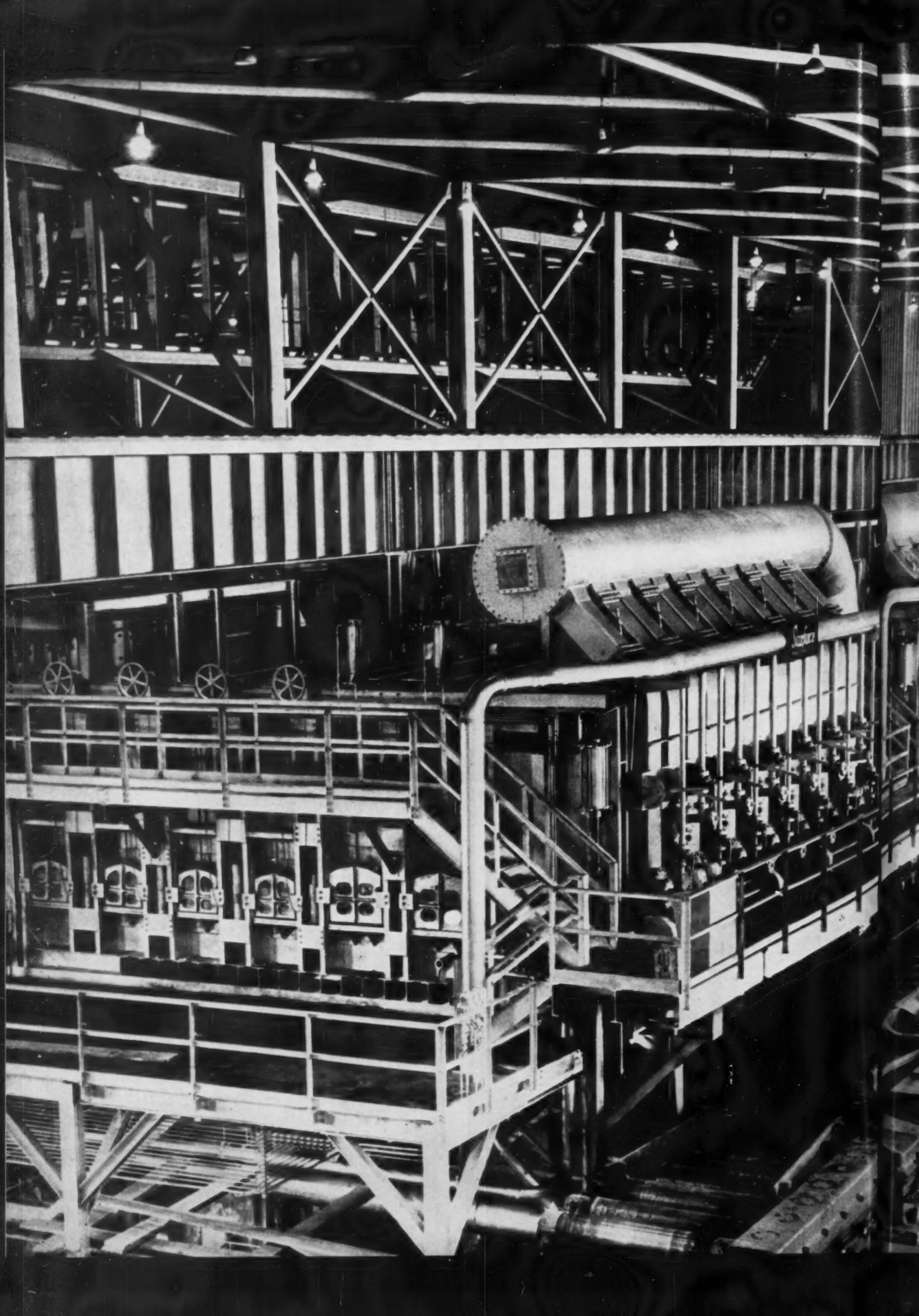
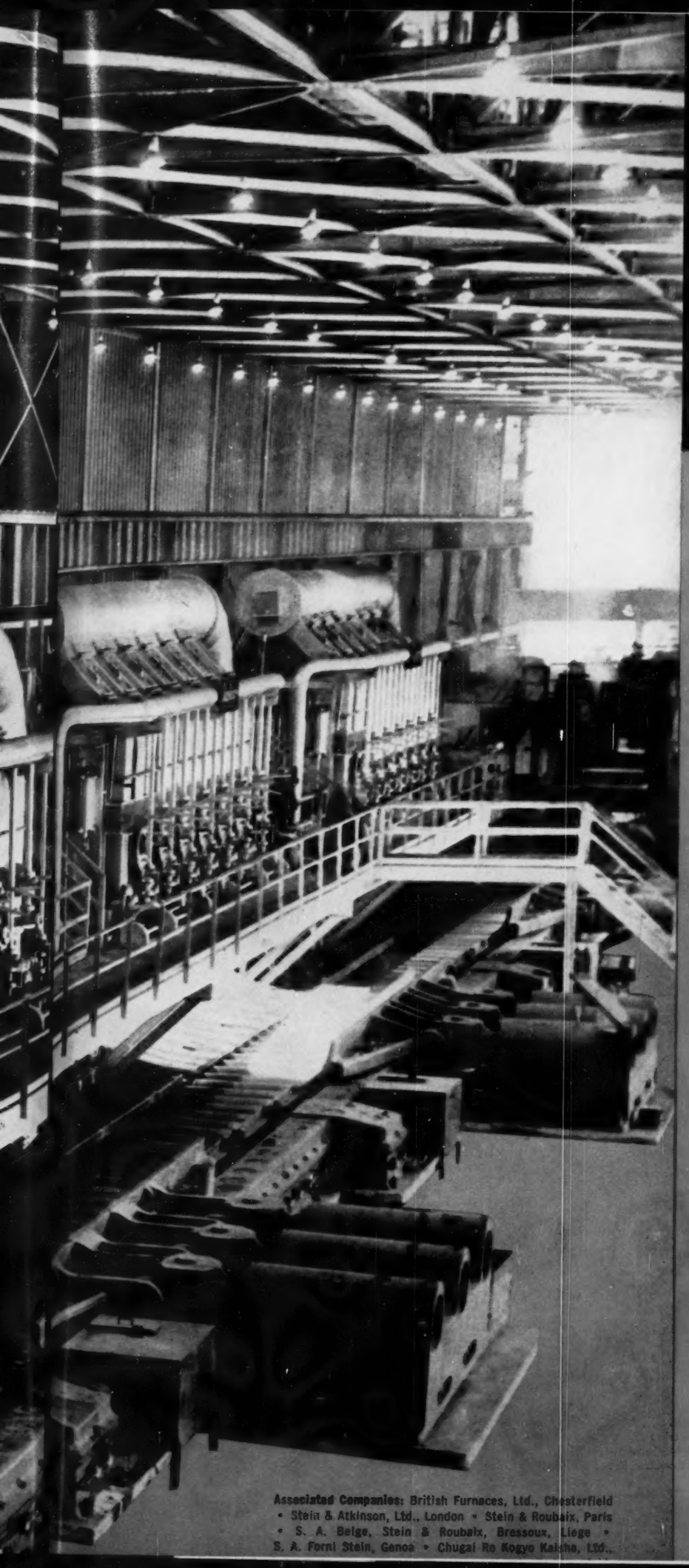
FAST'S Couplings

Engineered Products Sold with *Service*





200 TONS AN HOUR

CONTINUOUSLY

200 tons of steel slabs are heated to rolling temperature every hour, continuously, in each of these Surface monsters—world's largest slab furnaces.

No other furnace today can list all of these features:

1 Cantilever skid supports* permitting unobstructed combustion space for underfiring.

2 Furnace lines and burner design which provide high heat input from the moment the slab enters the furnace.

3 Built-in control* to prevent intermingling of gases from upper and bottom zones, providing better control of heat application, and preventing overheated slab end.

4 Anticipatory control which reduces temperature head when rate of slab discharge decreases.

5 Air preheat up to 1100°F.

6 Television signal to pusher pulpit, informing operator of the exact position of the leading slab.

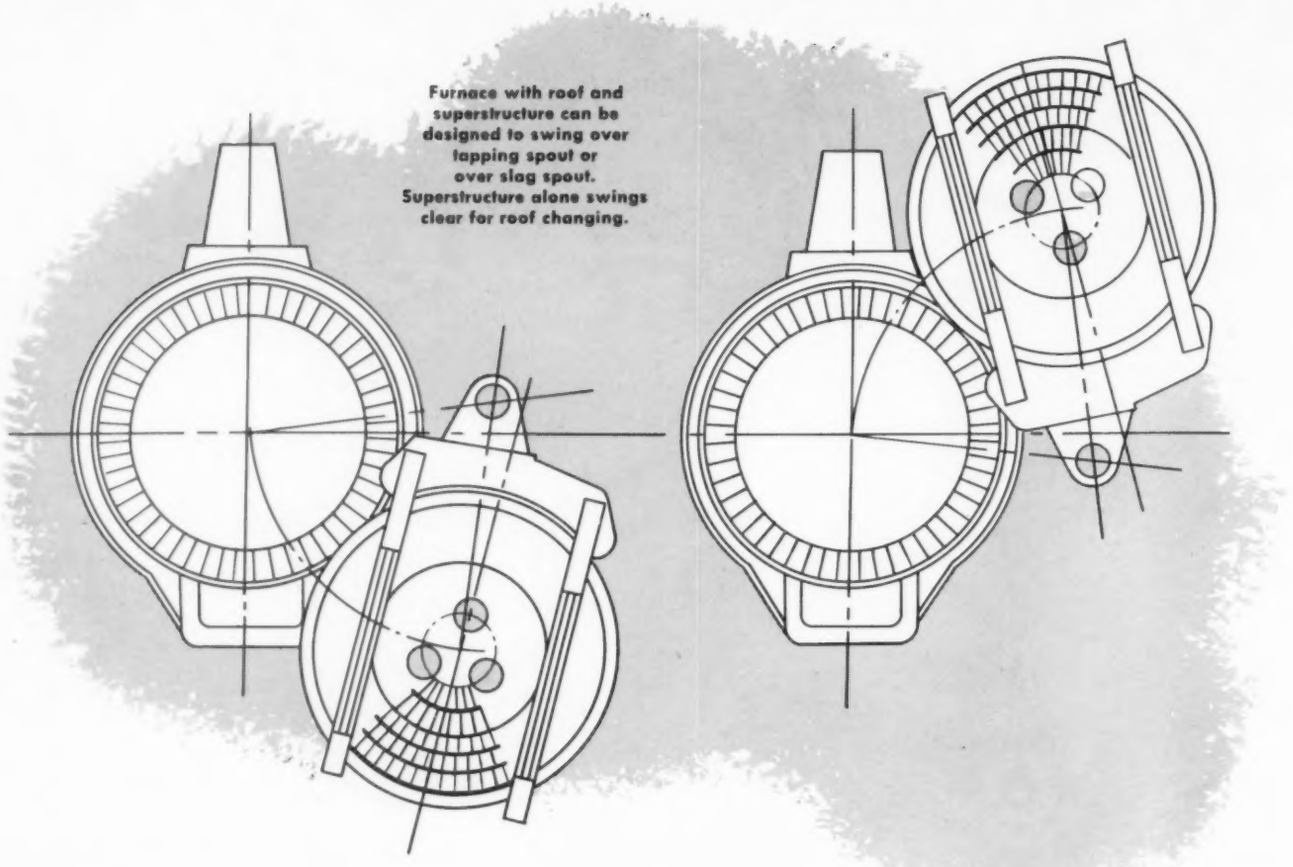
This is another demonstration that, at Surface, unconventional thinking and conventional experience are a productive team for the steel industry. Surface Combustion Corporation, 2404 Dorr St., Toledo 1, Ohio.

*patents pending

Surface

wherever heat is used in industry

Associated Companies: British Furnaces, Ltd., Chesterfield • Stein & Atkinson, Ltd., London • Stein & Roubaix, Paris • S. A. Belge, Stein & Roubaix, Bressoux, Liege • S. A. Forni Stein, Genoa • Chugai Ro Kogyo Kaisha, Ltd.,


Furnace with roof and superstructure can be designed to swing over tapping spout or over slag spout. Superstructure alone swings clear for roof changing.

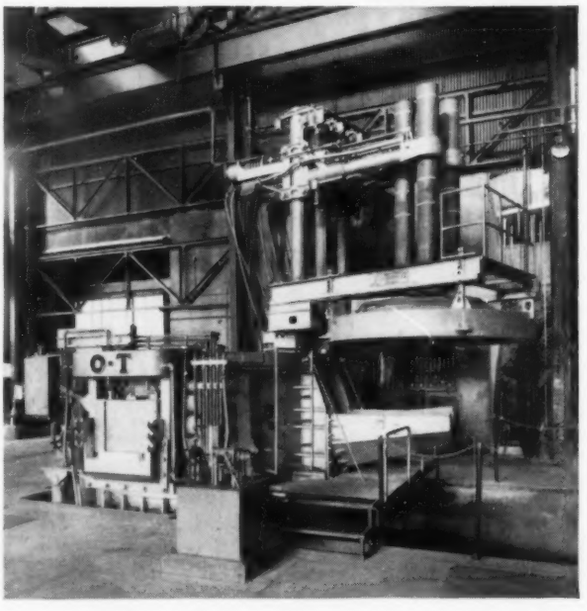
With a Lectromelt Furnace you have a choice

THE ROOF CAN BE BUILT FOR FRONT OR BACK SWING

SELECT the direction of swing that best fits your plant layout—over the tapping spout or over the slag spout. Lectromelt's design and method of separately supporting the roof structure makes this possible. You profit by the greater efficiency and convenience that result.

Note in the above drawing how the furnace top swings clear of the furnace; there's no interference with the charging bucket to slow down the charging operation. Lectromelt places the pivot point away from the furnace shell to accomplish this. And, because the swing of the top can be less, there's less strain on the conductors.

Catalog No. 10 describes Lectromelt furnaces. For a copy write Lectromelt Furnace Division, McGraw-Edison Company, 310 32nd Street, Pittsburgh 30, Pennsylvania.



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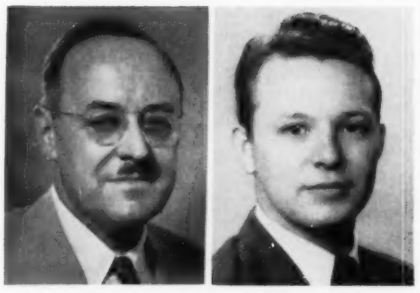
Allegheny Ludlum Steel Corp.'s New Forge Shop, Dunkirk, N. Y.

Emil Kern, Vice-President in Charge of Engineering, Allegheny Ludlum Steel Corp., Brackenridge, Pa.
and James E. Trabits, Plant Engineer, Allegheny Ludlum Steel Corp., Dunkirk, N. Y.



EMIL KERN J. E. TRABITS

. . . . many unique features have been designed into Allegheny Ludlum's new forge shop at Dunkirk . . . . all the facets of the operation—furnaces, material handling, presses, and auxiliary equipment—have been combined into a well-planned and efficient shop . . . .

ALLEGHENY Ludlum's new forge shop is a part of this company's main expansion and modernization program and had been under consideration for some time.

A 2000-ton general purpose forging press was required to shape large ingots of tool steels and special metals into blocks, slabs, heavy flats, disks and the like. In addition, this press was installed also to forge smaller ingots of these metals into blooms and billets on a production basis.

A desire to consider mechanization where practical and economical, to keep capital outlay and spare part requirements at a minimum and install a shop with low operating and maintenance cost, and in keeping with today's standards of safety and good housekeeping is reflected in the many ways this shop differs from conventional layouts.

Before and during the drawing up of plans and specifications, a good many forge shops in the United States and abroad were studied and analyzed. The most important press builders were also consulted. This was considered advisable because press shop tools, especially the forging press for this class of work, had not changed much during the last few decades in spite of its many shortcomings.

The study dealt with collecting facts on maintenance and life of equipment, occurrence of breakdowns, advantages and disadvantages of various press drives and their dependability and economy, also safety and insurance problems, and, last but not least, facts were compiled on the time proved machinery designs available and their performance and production records.

To sum up the results of the study, one had to keep in mind that every plant visited had a different production program to meet and no doubt the shop this paper deals with is no exception in this respect and acknowledgedly offered possibilities for solutions that may not have satisfied other shops.

Nevertheless, there were a great number of items of a general nature in every shop which could be pinpointed as needing improvement, but nothing was done about it perhaps for lack of funds, opportunity or determination to follow through with good ideas. The design of the forging press proper was mentioned already in this connection.

But then there were the material handling problems, the flow of the product through the shop, the hard manual work one encounters in a forge shop wherever one turns, the difficult way of handling tools like anvils or knives, the poor visibility and working conditions in the buildings, the awkward way of straightening a piece of shafting or a flat, the unsatisfactory way of forging close to size and so on. Many of these things could be improved upon in almost any shop.

There were also other aspects which received consideration in this new shop. Very important was the idea to use simple machine elements arranged in a simple way to facilitate maintenance and assist the

Figure 1 — The 2000-ton press was installed to shape large tool steel ingots and special metals and also to forge smaller ingots of these metals into blooms and billets on a production basis.

job trainer, to use fewer different elements if custom built but more of the same kind to protect operation from undesirable shutdowns if one or the other failed. This reduced spare parts requirements. Furthermore, the accessibility and ease of replacement of all parts subject to normal wear and tear was given thorough thought. Spares had to be built into the equipment wherever possible.

All these factors were considered worthy of attention as contributing to the increase of the operating coefficient or tons per month output of the shop instead of depending on the press alone, even though it may have a drive and control to permit 100 strokes per min. It was concluded that the speed of a press as expressed in strokes per minute was no indication of the efficiency of an entire press shop, no more than power consumption of the press could be used as a measure of economy in a press shop.

Allegheny Ludlum Steel Corp.'s Dunkirk Works employs approximately 2200 men, and produces over 200 principal types and grades of specialty steels. Products consist mainly of: tool and high-speed steel bars, wire and forgings, stainless steel bars and wire and similar products in special alloys, such as high temperature materials, automotive valve steels, titanium, etc.

The general trend in industry is towards larger forged sections. This actually is not unique in the forging business, but is common in all phases of steel production. The Dunkirk Works was limited to forgings that could be produced from an 18-in. square ingot. The new press shop is designed to handle ingots up to 15 tons, with provisions made to handle larger ingots in the future.

MATERIAL FLOW

Each day's work is planned in the work's central scheduling dept., the ingots being selected from the annealing and storage area. Depending on size, this material is stacked in furnace loads on specially designed pallets or may be loaded directly on trucks or trailers hauled by tow tractors to the press shop. Provisions have also been made for rail transportation. In some special cases the ingots are transported hot from the melt shop.

Upon arrival in the forge shop, ingots or loaded pallets are placed on the preheat furnace cars by overhead crane, using specially designed handling attachment. Upon completion of the preheat cycle, each palletized load of ingots is removed from the furnaces with the overhead crane and placed in front of the batch furnace in which they are to be charged.

The overhead charging machine then places the ingots into the furnace. When forging small ingots all the charger's time is utilized in serving the press, especially when several reheats are required. When forging large ingots, the charger has much more time available for auxiliary duties, which may include loading the high heat furnaces directly from the preheats. In this case the large ingots can be loaded directly on the preheat furnace cars by crane, using ingot tongs.

Upon reaching forging temperature, the charging machine delivers an ingot to the press, places it in the manipulator jaws and then removes the previously forged piece from the press die. This piece will be recharged into the batch furnaces if reheating is required, placed in a car type furnace for annealing, in a pit for slow cooling, on the transfer car for flame cutting or in a dirt area for air cooling, depending upon the type of steel and the next operation to be performed.

The annealing furnaces have doors at both ends, permitting the discharge of annealed material in the finishing aisle. The slow cool pit is located so that material placed in it by the overhead charging machine can be removed by the finishing aisle crane. In case of flame cutting, the piece is cut on the bed of a transfer car and can be removed with a crane in either aisle. The design and location of the above facilities for these intermediate operations eliminates a handling and transfer problem.

For added flexibility, the high-temperature car type annealing furnaces were designed to heat steel to forging temperatures. This feature accounts for itself very satisfactorily when physical dimensions of a forging exceeds the design limitations of the normal heating facilities or when problems of expediency, efficiency or emergency arise.

The charging machine is equipped with automatic door opening apparatus. This enables the operator to select and operate any furnace door from any position in the press aisle. It is also used to control a hydraulic lift and motorized ingot turnaround in front of the press. The turnaround retracts into the floor when not in use.

A six-ton manipulator is used at the press. It is remotely controlled from a floor mounted pulpit adjacent to the press. This pulpit also contains the press controls.

The simultaneous operation of both pieces of equipment was considered feasible due to the corporation's experience with one man operation of other equipment, such as, reversing mills, etc. Due to the automatic control of the press, this arrangement has worked out quite satisfactorily in actual practice.

The overhead 15-ton capacity crane, utilizing an idler forging block, is used to assist the manipulator in handling ingots beyond its capacity. A 50-ton crane

installed on a second level above the main crane runway in the press area can also assist in manipulation of forgings under the press die. Manipulation of large forgings can be accomplished by using the two cranes, one using a motorized and the other an idler forging block.

By installing one or two furnaces in the area serviced by the 50-ton crane, the maximum size forgings can be increased above the present 15-ton limit.

The material transferred to the finishing aisle is inspected, tested and prepared for shipment to the customer or other department of the plant for hammer recogging or rolling into various mill products. The materials may be machined, cut to size or ground before shipping from the shop, depending upon what is required for further processing in the plant or specified by the customer. Some materials must have intermediate conditioning on the billet grinder before press finishing.

THE FORGING PRESS

The 2000-ton general purpose forging press is of the two-column inverted type arranged for manual, semi-automatic and full automatic cycling.

The press has an uninterrupted stroke of 72 in. and daylight between bolsters of 10 ft. Column centers are 124 in. left to right, 80 in. front to back and its maximum height above floor is 19 ft-5½ in. The maximum die width which can be accommodated is 90 in.

The press is equipped with a lateral die shifting mechanism consisting of five 7-ft long sliding bolsters. The width of these boltsers is 48 in. They facilitate an entire die change setup for any particular operation requiring more than one type of die. A combination forging die and cutoff knife permits fast, efficient cutting of forgings under the press. Many other tools, such as, "V" dies, straightening dies, jackstands, upsetting bolster, etc., can also be mounted on the bolsters. The drive permits the interchange of bottom dies in 15 sec. Utilizing the slide, the top die can be changed in less than five minutes.

The power plant for the press consists of oil hydraulic axial piston type pumps driven in pairs directly. The total connected horsepower for these pumps, including several auxiliary oil pumps, totals 1568 hp. Although the pumps have capacity to cycle the press at greater speeds, it has been gratifying to observe operators with relatively little experience forge with 1½-in. bites, using 30 strokes per min and planishing with 60 strokes per min.

The direct pumping system permits instantaneous relief of all line pressure by depressing a single button which disconnects power to the drive motors. Also, the fluid pressure is maximum only for small increments of time, since its pressure is proportional to the resistance being encountered in cycling the press. At the press all piping is connected to parts rigidly fastened to the underside of the base. This eliminates fatigue stresses in the piping caused by any slight sway of the moving parts although not noticeable to the naked eye. The absence of overhead piping eliminates the possibility of accidental damage by overhead cranes or other handling facilities. All these factors spell safety even when using oil as a working fluid.

Figure 2 — Press design gives the operator excellent view.

Specific details of the press design and its control are the subject of a companion paper, entitled, "The Modern Forging Press and Its Control" by Otto Hoffman and Alex Krynytzky.

The main stationary press platen is resting on a sandwich of steel plates and synthetic rubber and is bolted securely to its foundation. The pit, which this platen straddles, is 25 ft 6 in. deep and provides ample room for the servicing of the press cylinder packings, pipes and operating valves.

Along side the press pit proper is the pump cellar, its floor being 14 ft below main floor level. In this same area are installed the service water recirculating pumps, the air circulating system, the prefill tank and other auxiliary equipment, including all electrical control cabinets.

This arrangement frees valuable floor space, around the press and the die slide, at the same time providing a normally satisfactory fireproof installation with additional safety in regards to any such hazard.

The circulating air system is of a combination 100 per cent make-up and recirculating type and provides sufficient air for motor cooling. As a safety measure, it is interlocked with a rate of temperature rise type fire alarm system. It also can supply ventilation at the operator's pulpit and fresh air to the bottom of the press pit. It can also syphon out objectionable gases from the pit, if this should become necessary during maintenance work in the pit.

No attendant is required in this pump cellar since all of the equipment housed therein needs only periodic inspection. This is done twice a day when inspecting the operating valves and main cylinder packings. These are readily accessible in the pump cellar from a permanent steel scaffolding arranged all around the press for this purpose. It should be noted that on this press installation, the press cylinders are located in the pump room, an area which is normally a cleaner place than the forge shop itself. All other parts, such as pull back cylinder packings and column wiper rings, are in easy reach from the shop floor.

The working floor around the press is designed for heavy loading. To promote good housekeeping, floor plates, two and three inches thick fitting tightly around the press base, have joints only on the heavy structural supports to make for a dust and scale proof cellar ceiling. The press base makes a natural cover protecting

Figure 3 — A six-ton manipulator is used at the press.

the cylinders and packings from such contaminates. To further promote good housekeeping habits in this area, special attention has been paid to the problems of draining and replenishing oil from reservoirs, tanks and related press elements. The system is filled from permanent piping originating beneath a cover on the control pulpit. A drain line extends to containers at the bottom of the press pit, which is removed through the cellar hatchway by crane.

Special tailoring of the relatively narrow top crosshead permits a very close approach to the die with handling equipment. This top crosshead, which is clean due to absence of prefill tanks, valves, piping, etc., eliminates any interference for these facilities and possible accidental damage to such auxiliary equipment by overhead cranes. Chains, etc., can be hung from the crosshead to assist in supporting pieces during the forging operation.

Noteworthy control features incorporate the control of the upper and lower limits of the press cycle by limit or adjustable pressure switches. The press is reversed by either the limit switch setting or selected tonnage, whichever is reached first. This permits forging or planishing to size or to any desired tonnage within the capacity of the press. Two sets of control limit switches, each individual switch being remotely adjusted from the pulpit, are provided for forging pieces with unequal sides such as flats, or for opening the dies to permit the rotating of squares, etc. Our experience indicates size can be held within less than $\frac{1}{8}$ in. by this method. To compensate for different height forging dies, the limit switch scale can be zeroed.

Figure 4 — The pulpit contains both the manipulator and the press controls.

Through a selector switch, the operator can cut in or out the delivery of ten pumps any time during the operation without stopping the drive motors. By controlling the number of pumps delivering oil to the cylinders, he controls the forging or planishing speed as he wishes.

In case of emergency, the operator can interrupt the cycling and return the press to its uppermost position by depressing the emergency stop button. This does not disconnect the power to the pump motors, and, therefore, keeps them running for immediate resumption of operations. However, there is another emergency motor stop button provided, which if depressed, stops the press and all components of the power plant instantaneously.

The relatively simple press control, along with good visibility afforded by the two-column design, permits the press operation from the specially designed manipulator control pulpit mounted on the shop floor.

All press and auxiliary operations, including main line electrical disconnect switch, individual motor start switches, selector switches for the types of operation and operating control limits, individual limit switch setting, scale zeroing, die shifting mechanism, speed and tonnage control, etc., are remotely controlled from this pulpit.

All controls are conveniently placed in accordance with their frequency of operation and in a similar position on the pulpit in respect to the operator as the drive for the particular motion it controls on the equipment. Wherever possible, they are arranged so that the movement of the controls affects a corresponding movement of the work piece under the press. Having mounted each control within easy reach and at the proper elevation and angle relative to the operator for the most natural and comfortable arm and leg movements, it greatly reduced operator fatigue.

The six-ton capacity manipulator travels on rails embedded in the floor and is of a standard straight line design with the frame straddling the peel. It has all motions normally found in this type equipment, such as angular and straight slewing, parallel and angular vertical lift in respect to the floor, peel rotating, forward and reverse travel, etc. The gripper arms are arranged to handle pieces from 3 to 60 in. and provisions are made for fast interchange of different type jaws or buttons. Special designed jaws are provided to permit the forging of sections down to 4 in. square from end to end under the press die without the necessity of turning the piece.

FURNACES

Since the Dunkirk plant is a specialty steel producer, production is of a jobbing nature. Many different types and grades of steels are forged which require various forging, annealing and treating temperatures. These factors cause a scheduling problem which have greatly influenced the type and design of the forging shop furnaces.

Three car-type furnaces are provided for preheating. Three pallets of steel can be placed on each furnace car. Physical dimensions allow for heating a 4 ft high load on a usable hearth area of 19 ft-$2\frac{1}{2}$ in. by 6 ft-4 in. All material is supported a foot above the

top of the car refractories by furnace bars and alloy piers. A total of nine 2½-in. gas burners fire in the void beneath the load. The burners have sufficient capacity to heat 90,000 lb of steel plus pallets, furnace bars and supports to 1500 F in 14 hr. Combustion air is supplied by a 5-hp, single-stage, 63,000 cfhr blower at 10 ounces. Three 29-in., 3-hp, 1000-rpm fans inserted in the roof of each furnace provide constant air circulation to insure good temperature uniformity throughout the load. Alloy blades and water cooled bearings permit their operation up to temperatures of 1650 F. The car is driven by a rack and pinion drive which is electrically interconnected with the door. The car cannot be moved until the door is completely open.

A total of five out of six batch type furnaces are installed in the shop. Each furnace has two compartments which are controlled and operated as individual furnaces. All hearths are approximately eight feet wide and four feet above the floor. Four furnaces have effective hearth depths of twelve feet. The other is sixteen feet deep to permit the recharging long billets for reheating.

Ingots are charged into the furnaces in two rows. Due to the generously large door openings, sections up to 18 in. square can be removed over the top of the front row with the overhead charging crane. Partially forged pieces can also be recharged into the same furnace if more than one heating cycle is required. Each chamber of the twelve foot furnaces is fired with five 2½-in. gas burners and are equipped with furnace pressure controls. Combustion air for each furnace is supplied by a 24-ounce, 115,000-cfhr, 20-hp, single-stage blower. The burners have a capacity to heat 15,000 lb of steel from room temperature to 2200 F in four hours or 30,000 lb in eight hours when charged into a 1500 F furnace. An individual blower of the same size and an extra burner is used for each compartment of the sixteen-foot furnace.

The three car-type furnaces used for heating ingots or annealing are all of identical construction. Each has an effective hearth area of 8 ft wide by 16½ ft long. The furnace chamber and doors are of sufficient height to permit the placement of material in the furnace with the overhead charging crane. A rack and pinion type car drive and door on each end of the furnace allows the car to be charged or discharged in either of the main building aisles.

Each furnace is fired with seven 1½-in. gas burners in two rows on each side, three being mounted on top and four on the bottom. The lower burners fire against a fire brick wall to prevent flame impingement on the steel. Combustion air is supplied with a 10-hp, single-stage, 69,000-cfhr, 20-ounce blower. The high temperature annealing furnaces, which double as forging furnaces, have a control range of 1300 to 2300 F. They have burner capacity to heat 25,000 lb of steel from room temperature to 2000 F in four hours when placed in a 1500 F furnace. Optimum temperature uniformity is obtained from 1700 to 2300 F. However, they can be used for low temperature anneals down to 1400 F where very close temperature uniformity is not required. The low temperature annealing furnace has a control range of 1300 to 1800 F and is equipped with furnace pressure controls. It has burner capacity to

Figure 5 — Press is of the two-column, inverted type and is arranged for manual, semi-automatic and full-automatic cycling.

heat 20,000 lb of steel from room temperature to 1425 F in eight hours. These gas fired car furnaces have sand seals completely surrounding the car to prevent air infiltration.

All furnaces utilize completely closed-in type, nozzle mix, excess air burners arranged for conversion to dual fuel at a later date. Variable ratio regulators on each burner permit correct fuel-air ratio on high fire and an increasing percentage of excess air as burners are throttled. This provides an effective high turndown ratio and improves temperature uniformity. Wherever necessary, furnace pressure controls were added to maintain a positive pressure in the heating chambers and thereby promoting maximum temperature uniformity. All have single zone automatic proportional controls with two points recording and one controlling. In addition, the preheat furnaces have a program type control permitting adjustable heating rates from 0 to 200 F per hr. Safety features include a manual reset automatic shutoff valve actuated by either low or high pressure gas or low pressure air switches. Since the preheat furnaces must operate at low temperatures, they are also equipped with supervisory cock systems for added safety.

To complete our present requirements, an electric draw furnace with a maximum operating temperature of 1650 F is provided. The physical dimensions of the effective hearth area and height are essentially the same as the gas-fired annealing furnaces. The car, drive and doors operate in the same manner. Nine, 220-volt heating elements arranged in three zones with a maximum instantaneous input of 405 kw are connected to a 440-volt, 60-cycle, 3-phase electrical source through a suitable transformer. Each zone has its own individual temperature control. It is designed to heat 25,000 lb of steel from room temperature to 1550 F in twelve hours, hold for a specified time and then cool at a maximum rate of 50 F per hr. For temperature uniformity, constant air circulation is obtained with four 3-hp, 23-in. fans mounted in the roof. They have a maximum operating temperature of 1750 F. As in the car type gas-fired furnaces, a sand seal is provided completely around the car.

To keep capital expenditures for spare parts to a minimum, all furnaces were designed with duplicate equipment and parts wherever possible. All gas furnaces have the same style burners and therefore du-

Figure 6 — The forging furnace had to be designed to give extremely flexible operation.

plicate burner plates. The batch type and preheats have identical burners. All gas-fired car furnaces utilize identical sand seal castings, pinions and gear racks. In addition to these parts, the three annealing furnaces have the same car drive units, door lift drives, wheels, chain pulleys, door frames, jambs, breast plates, etc., as other furnaces in the plant.

Space is provided for the installation of a car type heat-treating furnace plus water and oil quench tanks. As previously stated, all furnace doors facing the press aisle are remotely controlled but a selector switch for each door is also provided for manual operation.

FURNACE CHARGING EQUIPMENT

The furnaces are serviced by a 12-ton overhead charging crane. To cover the full size range of products, including flats up to 60 in. wide, the machine would have required two sets of tongs. A considerable amount of the production is in small forgings weighing under four tons. The physical size of the 12-ton capacity peel, head and tongs are large and cumbersome when handling small ingots and limit the number which can be placed in a furnace. Therefore, for this class of work an additional 4-ton capacity peel assembly with tongs was purchased and can be interchanged with the 12-ton assembly in less than ten minutes.

The vertical operating range of the peels permits the machine to grasp a work piece from the shop floor and yet reach to a height of 8 ft-6 in.

The bottom of the operator's cab, which is the lowest point on the machine, is six feet off the floor. This arrangement, along with the two-column press design, permits the charging machine to handle work pieces from the sides of the press for straightening on dies or flat bolster, and permits handling tools, inserting mandrels into sleeves, etc. Charging the furnaces over the top and from a pallet placed in front of the furnace door conserves the charger's time by reducing the number of motions and distances that must be traveled. Also, this feature allows much of the floor area to be utilized for storage without limiting this machine's service area.

Since the next step in the charger operator's line of promotion is control of the manipulator, the same type of operating controls are installed in both machines. The controls for similar motions are mounted in the same relative position.

Other design features of the charger include: the mounting of peel hoist cable sheaves on springs to prevent the accidental imposition of excessive strains on the cables, a double bridge drive, full magnetic control for all motions, and dynamic bridge braking in case of power failure. The crane has a bridge travel speed of 225 fpm and a trolley speed of 155 fpm.

For additional flexibility and to insure the continuous operation of the press, a 20,000-lb capacity lift truck, equipped with a billet grab attachment, is provided as a second charging machine. It is used to service the press when operating difficulties are being experienced on the overhead equipment or while the peels are being interchanged. The same man operates both pieces of equipment.

As in the case of the overhead machine, the floor charger is also equipped with variable frequency furnace door operating apparatus. The ingot turnaround can also be operated from this machine.

OVERHEAD CRANES

In addition to the 12-ton furnace charging crane, the press aisle is serviced by a 15-ton crane with a five-ton auxiliary hoist.

Although the rail height is only 25 ft, the inverted press design permits both cranes to travel over the top of the press and service the full floor area. A duplicate 15-ton capacity crane is installed in the finishing aisle. The main and auxiliary hoists have full load speeds of 40 and 60 fpm, while the bridge and trolley speeds are 350 and 150 fpm. Many mechanical and electrical parts on these cranes are interchangeable with cranes in other departments. This assists in keeping spare parts inventories to a minimum.

A five-ton capacity floor operated crane is installed in the lean-to aisle. In addition to serving as a maintenance crane for the equipment in the furnace aisle, it services the press power plant through a hatchway cover. It has a maximum hoist speed of 46 fpm, bridge and trolley speeds of 200 and 125 fpm.

As previously mentioned, a 50-ton crane with ten-ton auxiliary was installed over the press area for the erection and maintenance of the press and is used to assist in the forging operation whenever necessary. The extra headroom afforded by the 50-ton crane over the press was especially advantageous in installing the columns. Special lift beams in the trusses or above the roof line were not necessary. This crane has main and auxiliary hoist speeds of 14 and 56 fpm and bridge and trolley speeds of 100 and 132 fpm.

All cranes have full magnetic control with dynamic hoist lowering. Bridge and trolley travel controls are reversing plugging, with the exception of the floor operated crane, which utilizes magnetic brakes.

AUXILIARY EQUIPMENT

A standard heavy duty, 100 hp horizontal spindle milling machine is provided for milling billets, slabs, die blocks, disks and octagons. The machine has a vertical spindle movement of 60 in., table feed of 12 ft, quill movement of 15 in. and table width of 60 in.

With proper fixtures, this machine is capable of machining die blocks up to 48 by 48 by 36 in., and sides of disks, octagons and squares having a minimum

thickness of 3 in. Widths and lengths must necessarily be within the range of the machine and fixtures.

Any section within the size limits of 18 by 24 in. can be cut on a horizontal type, hydraulically-controlled automatic band saw. It utilizes a high-speed steel cutting blade. Motorized inboard and outboard roller conveyors are provided for moving sections in and out of the cutting area. Small, heavy pieces, which are too short to be positioned by the power rolls, are pushed under the saw blade by hydraulic cylinders. The material is held rigid by hydraulic clamping devices on each side of the blade. A screw conveyor transfers the chips from the machine's housing to a steel belt type conveyor which discharges them into a scrap bucket.

For flame cutting, an oxygen-acetylene torch with powder cutting attachment is mounted on an elevating platform between the two main building aisles. Forged sections are cut on the bed of a transfer car running on rails perpendicular to the torch carriage. The car can be loaded by the furnace charging machines or by a crane in either building aisle. The elevating platform permits the cutting of sections between the limits of 6 to 48 in. square. The car drive can be controlled from either the platform or floor for positioning it under the torch or for transfer of material between the two aisles. Counterweighted hood with telescoping duct work above the cutting area collects the fumes which are exhausted by means of a 36-in., 20,000-cfm, axial-flow blower. The exhaust hood is attached to the frame of the elevating platform. This keeps the hood close to the point of cutting at all times. A full curtain on one side of the hood, the platform on the opposite side, and partial curtains on the ends confines the smoke and fumes for easy removal.

Oxygen for the torch is piped from the plant's central receiving station. Acetylene is supplied from several acetylene bottles connected to a common manifold.

A billet grinder is provided to grind sections up to 16 in. square by 13 ft long. It is equipped with a special loading, unloading and turning device. Billets are clamped on a table which traverses under the grinding wheel. The grinding head moves perpendicular to the table in both the vertical and horizontal direction. The 18 by 2½-in. abrasive wheel is driven by a 40-hp, 230-volt, adjustable speed motor and has an adjustable working pressure up to 330 lb. Grinding can be controlled automatically or manually from a central control cabinet. Table and wheel head transverse feeds are variable between 20 and 52 fpm and 0 to 20 fpm respectively. Due to the stationary wheel, grinding dust collection and segregation is relatively simple. The housing supporting the grinding head acts as a receiving chamber for the grinding dust. The heavier particles fall on a conveyor which transfers them to a scrap bucket. The fines are collected in a centrifugal type separator and are discharged on the same belt conveyor as the heavier particles.

BUILDING

The press shop covers approximately 60,000 sq ft, excluding lean-to for offices and washroom facilities. Its location within the works boundries permits future expansion. The building is comprised of two main aisles under a common roof. A furnace lean-to aisle is attached along one side of the main building while the offices, washrooms and locker rooms are located in a lean-to on the opposite side.

Both main building aisles have crane spans of 65 by 350 ft long and crane rail heights of 25 ft. The furnace lean-to aisle has a crane span of 21 ft-6 in. and a rail height of 21 ft-¾ in. Over the press area a second crane runway for the 50-ton crane is located 17 ft above the main runway.

In order to maintain today's standards of good housekeeping, over 95 per cent of the total floor area will be paved. The small area not paved is to provide for placement of hot steel from the annealing furnaces, or press for cooling. Paving brick layed on a 9-in. concrete slab is utilized in the area around the press and furnaces. Main aisles, which encounter heavy traffic, are paved with steel plates embedded in concrete. Wood block floors are provided in the machine tool areas in the finishing aisle. All other areas have concrete floors. Consideration was given to the exterior looks of the building since the works is located within the city limits of Dunkirk. A four-foot brick perimeter wall surrounds the building. The balance, except for the steel sash areas, is covered with stainless steel siding. This type construction offers an attractive, maintenance-free building.

The ¾ in. to the ft low pitch roof is constructed of galvanized steel decking with built up roofing on 1 in. of insulation.

The building has a 48½-ft wide monitor section over the annealing and heat-treating area. Hot gases from the furnaces rise into this section where they are removed by eight 48-in., 3-hp, 31,000-cfm power ventilators. Four identical units are installed in the high building section over the press area. A row of eight 30-in., 11,000-cfm units are provided on the lean-to which removes the heat and products of combustion from the batch type and preheat furnaces.

Spacing of the crane runway columns between the main aisles is wider than in most conventional designs. This provides ample space for the installation of fume and smoke exhaust ducts for equipment in this area requiring such facilities.

A lifting beam is provided in the building trusses of each aisle for servicing the overhead cranes.

Four 1,500,000 and one 1,000,000-Btu per hr, gas-fired, floor-mounted heaters insure comfortable working conditions in areas not receiving sufficient heat from the production facilities.

A combination of mercury arc and incandescent fixtures provide adequate lighting in the shop. In each main building aisle, a row of three 1000-watt, 440-volt fixtures are attached to the bottom chord of the trusses, spaced every 25 ft. All are mercury arc, except for the center fixture in every other row, which is incandescent. Actual tests indicate 25 to 30 footcandles at floor level under the high roof and 40 to 45 footcandles in the remainder of the building.

UTILITIES

Electric power is purchased from the utility company serving the area at 115,000-volts, 60-cycles, 3-phase. This is reduced to 4800 volts at the plant's main substation. A bank of three transformers at

the press shop having a total capacity of 2500-kva serves the equipment with 480 volts. Necessary d-c power is carried from the substation motor-generator sets to the press shop at 250 volts.

All service lines, with the exception of the recirculating water line, enter the building at a central point. Shutoff valves are conveniently located for operation from the floor. These lines are layed together to a main valve pit, which is located outside the building beyond any contemplated paved areas. An emergency fuel oil line is capped off in this pit and will be connected to the plant's main fuel oil line if and when it ever becomes necessary. Inside the building, all lines loop around the outside walls with an inter-connecting line running along the center row of building columns. The recirculating line enters the building in the press power room and is connected to the recirculating pumps. An emergency inter-connecting system is provided to supply the recirculating water mains with city water in the event of pump or power failure. In addition to the fire hydrants which are located along the city street a short distance from the building, one is provided at each end of the shop between the large doors for added protection. All service lines are of sufficient size to fulfill present and future requirements.

Discussion

PRESENTED BY

W. L. GOVAN, Loewy-Hydropress Div., Baldwin-Lima-Hamilton Corp., New York, N. Y.

EMIL KERN, Vice President in Charge of Engineering, Allegheny Ludlum Steel Corp., Brackenridge, Pa.

W. L. Govan: Congratulations are due Messrs. Kern and Trabits and Allegheny Ludlum Steel Corp. and its staff for having its own original ideas on how a forging press should be built, and its willingness to back up its ideas with hard cash.

We might take issue, on behalf of ourselves and all other press manufacturers, with the statement that forging presses have not changed much during the last few decades. At this point it is sufficient to say that only ten years ago almost all forging presses in this size range were steam, but today very few steam presses are sold. Recently, our company has built quite a number of water-hydraulic forging presses, which for rough forging work can make up to 40 strokes per min, while for planishing work well over 110 strokes per min are attainable.

The use of a down-pulling press is interesting. This is basically an old idea, still used for special applications. For example, the 35,000 and 50,000-ton closed die forging presses built by our company for the Air Force heavy press program are down-pulling. There are many pros and cons.

However, there is one point we would like to make. We have just heard described a forging plant with 50-ton and 15-ton overhead cranes operating on different levels, plus a track type 6-ton manipulator and an additional overhead charging machine, a pit 25 ft-6 in. deep for the press and a 14-ft deep cellar for the pumps. All this makes a remarkable forge shop, but anyone can see it adds up to a lot of money. We are in the business of selling presses, and we would like to reassure any prospective customers that it is possible to go far on less.

For example, we recently sold a press of comparable size to a shop also engaged in making tool steels and other alloy steel forgings. The press was installed in an existing building, with only 18-ft headroom below the lower chords of the roof trusses. There are no overhead cranes at all. The press actually extends up between the roof trusses, its over-all height above floor is about 25 ft. The soil condition was solid rock. The press foundation is only 6 ft-6 in. below floor level. While some valves are located in a trench, the pumps are on floor level, out beyond the main bay, and in a separate, clean enclosure.

The paper mentions that the 50-ton crane, running on a second higher level, was able to install the press columns directly. In our case, a very interesting feature of this press was the erection. Due to our special design, erection was carried out by stacking all three crossheads on the foundation, dropping the tie rods in place (removable bushings in all three crossheads make this very easy) and then raising the upper and intermediate crossheads. Despite the low headroom, the whole erection was accomplished without any removal of roof or roof trusses, using only two riggers' or wreckers' cranes mounted on rubber-tired automotive trucks, and running on the unfloored ground. Actually only one such crane was needed, as the crossheads could have been raised by jacks or even using the press hydraulic system.

Thus without detracting in any way from Allegheny Ludlum's achievement, for those who wish to start or modernize in a smaller way, there are many attractive alternative solutions.

Emil Kern: Mr. Govan's speaks from experience. However, it is difficult for me to understand how the installations Mr. Govan mentions can readily be compared with a general purpose forge shop such as Allegheny Ludlum has built for special steels and for ingots ranging from one ton to fifteen tons, and larger in the future. And I must admit that I lost Mr. Govan completely when he implied that under certain conditions overhead cranes are not even required.

In our case, a 50-ton crane was required for occasional large ingots which would have to be forged with the aid of a porter bar, and this crane could also be used for installation and repair purposes, not only for the press itself but also for the charging machine and other crane, if mounted on a higher level. Due to its secondary importance, this crane was obtained in the second-hand market. Since the building was all new, the additional building cost was considered negligible, especially so because expensive floor space was freed by having this crane out of the way when not in use.

The pull-down press does require a deeper pit than a conventional press, but also requires a lower building. Our installation cost analysis proved that with this design we could even afford to have cranes and furnace charging machine travel over the top of the press, thus opening up interesting ways in using this equipment for other than normal functions.

The cost of this press was lower than any other conventional type press we analyzed considering cost of all mechanical equipment, electrical equipment, foundations, piping, floor plates, etc., including installation. ▲

A Modern Forging Press and Its Control

by Otto Hoffmann, Vice President—Engineering
and Alex Krynytzky, Supervisor, Mechanical Engineering
Lake Erie Machinery Corp., Buffalo, N. Y.

O. HOFFMANN A. KRYNYTZKY

. . . . accurate control of penetration speed is an important feature of the direct drive on this forging press . . . . flexibility of operation, visibility, and room are other outstanding features . . . .

IN order to obtain maximum flexibility and production to meet the varying demands of the modern forge shop, the hydraulic forging press built for Allegheny Ludlum Steel Corp., Dunkirk, N. Y., is of the pull-down principle, two-column type, self-contained, oil-driven with multiple lateral tool slide running right to left, as shown in Figure 1. Furthermore this press is equipped with the most up-to-date automatic controls requiring the minimum amount of physical effort of the one operator controlling the movement of the press and the manipulator.

CHARACTERISTICS OF A MODERN FORGING PRESS

A modern forging press can be defined as a unit rigid enough in its construction to withstand the heavy and varied duty imposed upon it up to its rated capacity. One of the most severe requirements imposed on any forging press is the ability to withstand large overturning moments which result from eccentric loading of the press.

For some time in the past, only moderate speeds were available, but now higher speeds are obtainable for even the biggest presses. Not only the penetration rates but also the idle movement speeds (closing and return) have been increased, to obtain faster cycling of the press—thus keeping the number of reheats to a minimum. It appears that by decreasing the valve time and increasing the idling motion speeds, more over-all time gain will be economically accomplished than by increasing penetration speeds. In case of 3-in. closing, 1-in. pressing, and 4-in. return-cycle, pressing amounts to 0.32 sec only out of 2.0 sec required for the complete cycle. The speeding up of idle movement is of particular importance where the high penetration speeds cause a too rapid rate of working for some special alloy steels and nonferrous materials. It is known that resistance to plastic flow is proportional to the rate of deformation. This is particularly evident at elevated temperatures of materials having high creep resistance.

In general, aside from mechanization and control centralization of the material handling and related equipment, the press itself can best contribute to the efficient operation of a modern forge shop by the following:

1. Having the ability to deform the given material with a controlled capacity.
2. The ability to forge automatically to preselected dimensions, by using efficient position controls.
3. The use of fully controlled penetration speed at rapid advance and return.
4. The utilization of multi-slide table for quick tool changing.
5. By making the operation of the press, as well as its maintenance—simple, foolproof and safe.

PRESS PROPER

Figures 2, 3 and 4 show comparative views of the two designs of a 2000-ton hydraulic forging press.

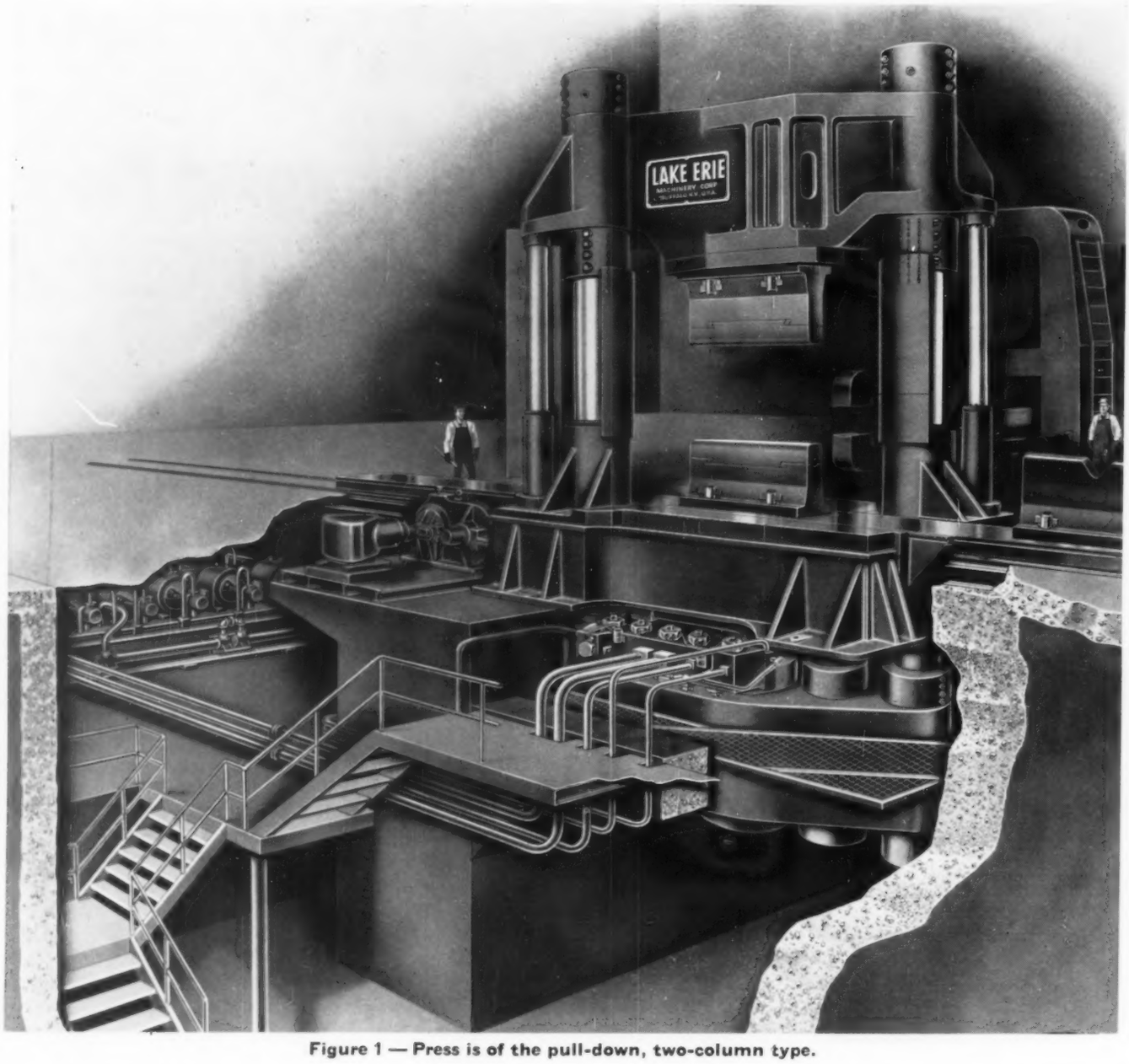


Figure 1 — Press is of the pull-down, two-column type.

Views to the right represent the 2000-ton, three-cylinder pull-down type press built for Allegheny Ludlum Steel Corp. The press proper can be divided into the stationary and the moving members. The stationary members are: the bed or base platen, the three rams, the two column guides and the pushback cylinders. The base platen supports the remaining press members.

By virtue of the pull-down principle, the base platen is mostly subjected to compression stresses only. Secured to the underside of the bed are the three rams. Inserted in and secured to the bottom platen are the two heavy column guide units. These units pass through the bed and are pre-stressed with the heavy nuts, thus forming an integral part of the base platen casting. The guides are equipped with bronze bushings, top and bottom, and are over ten feet long.

The rigidity of the column guides is the most important feature of the two column pull-down type press. Also inserted in the base platen behind the heavy column guides are the two pushback cylinders. The main reason for attaching the pushback rams to the uppermost member of the press, i.e., the top crosshead, is to avoid the stress reversal in the columns produced by the weight and inertia of the moving press members.

The moving members of the press proper are: the top crosshead, the two columns, the lower or cylinder crosshead, including the cylinders, as well as the two pushback rams which support the moving weights.

The top crosshead spans the work area on the diagonal and is cored for the passage of the two columns. It has an unusual shape which permits the working widths of the crosshead to be very narrow for close approaches. This width cannot possibly be obtained with the conventional overhead press design because of the outside dimension of the cylinder. The columns are secured rigidly to the crosshead by the split nuts top and bottom. The column section between the nuts is pre-stressed to provide rigid corners of the moving frame. The columns extend downward passing through the column guide of the base platen and on

through the cylinder crosshead. These columns are secured to the lower crosshead in a similar way to the top crosshead, being pre-stressed by means of proper preheating before tensioning.

Inserted in the lower crosshead are the three cylinders mating with the stationary rams, which are mounted on the underside of the bed. The cylinders complete the moving assembly which represents a closed frame with rigid corners moving up and down in rigid and long guides.

The corresponding views to the left in Figures 2, 3 and 4 represent a typical forging press of fairly recent conventional design. This press proper consists essentially of the stationary bottom platen, four columns, the fixed top platen including the three hydraulic cylinders, and the moving platen with the rams. The hydraulic prefill valving with prefill tank and all the necessary low and high pressure piping, are also located on top of the press. This results in an excessive over-all height of the press which in turn, necessitates high building and crane construction. A slender design of the press results in the center of gravity of the press being located several feet above the floor, thus making the press look top heavy.

The three cylinder arrangement for the pulldown type press was selected mainly because it offers faster cycling when forging on the side cylinders only, while the center cylinder is being prefilled. It results in efficient forging operation while processing small billets which do not require the full capacity of the press.

Provision was made in the press for the future addition of a hydraulic ejector.

PULL-DOWN TYPE

An inverted press construction of the pull-down type requires very low headroom, thus resulting in accessibility for cranes, and eliminating the necessity of high building construction.

The center of gravity of the pull-down type press is considerably lower than with the conventional overhead design, resulting in more rigidity and stability of the press proper. The press height above the floor is only 19 ft-6 in. as shown in Figure 2. Considering the 2000-ton capacity, the 72-in. stroke and the 120-in. daylight between bolsters, this overhead dimension does not appear to be objectionable, even for existing forge shops. This design, however, requires deeper foundation. A conventional, four-column press of the same specifications would protrude above the floor much higher than the pull-down type. As a matter of interest for installations in western part of our country where design for earthquake conditions is necessary, the low vertical center of gravity is of distinct advantage.

Since the main working cylinders are located under the press bed the hydraulic piping above the floor is completely eliminated. The cylinders are well protected from scale, dirt and fire. The only press members above the floor, are the top crosshead, column extensions with the column guides, pushback rams behind, and the anvils. The absence of the hydraulic cylinders, the prefill tanks, prefill valves and hydraulic piping on top of the press is an example of the true meaning of the word "safety." The inverted type also provides better visibility for the crane and charging machine operators, as well as for the rest of the forging shop crew.

Another advantage is the narrow top crosshead to allow as close an approach as possible for ingot handling equipment.

Wear of the cylinder bushings and packings is considerably less with the pull-down press-cylinders being under the base platen, and therefore not directly subjected to the effects of the off-center loading which occurs above the bed. In the case of a conventional overhead press, eccentric loads produce continuous rocking of the rams within the cylinder.

Where it is necessary to replace an existing forging press with the one of higher capacity and longer stroke within the low headroom of an existing shop, the pull-down type design will prove to be the most economical.

TABLE I
Specification Data of Press

Type	Two-column, pull-down, self-contained oil-hydraulic
Capacity	2000-ton maximum forging 945-ton forging and planishing
Press dimensions	90 in.—Right to left between column shields 48 in.—Front to back to clear tool slide 72 in.—Maximum stroke 120 in.—Daylight between bolsters 138 in.—Daylight between platens 120 in.—Long column guides 19 ft-6 in.—Maximum over-all height of press above the floor 13 ft-6 in.—Minimum over-all height of press above the floor 25 ft-0 in.—Approximate depth of foundation 48 in.—Front to back top crosshead
Tool slide	Six sections @ 84 in. long x 48 in. wide each 42 ft-0 in. over-all length
Duty specifications	Forge—2000-ton—up to 30 strokes per min at 3 in. close, 1 in. press, 4 in. return Maximum upsetting stroke at 2000 ton—72 in. Forge—945 ton—up to 60 strokes per min at 3-in. stroke Planish—approximately 90 strokes per min at 2-in. stroke
Drive	Twenty-axial piston constant delivery type pumps Total pump output—700 gpm Total pump hp—2000 Installed motor hp—1500 Ten—electric motors—150 hp each
Pilot and tool slide drive	60-hp pumping unit
Cooling	5-Hp pumping unit Single pass oil cooler Heat exchanged—700,000 Btus per hr—cooler Water required—140 gpm entering at 75 F—out at 85 F
Fluid	Hydraulic oil—300 SSU at 100 F Total tank capacity—3500 gal
Oil transfer pumping unit	3-Hp 36 gpm
Hydraulic efficiency of the press circuit	90 to 94 per cent
Average power consumption	226 Kwhr per operating hour

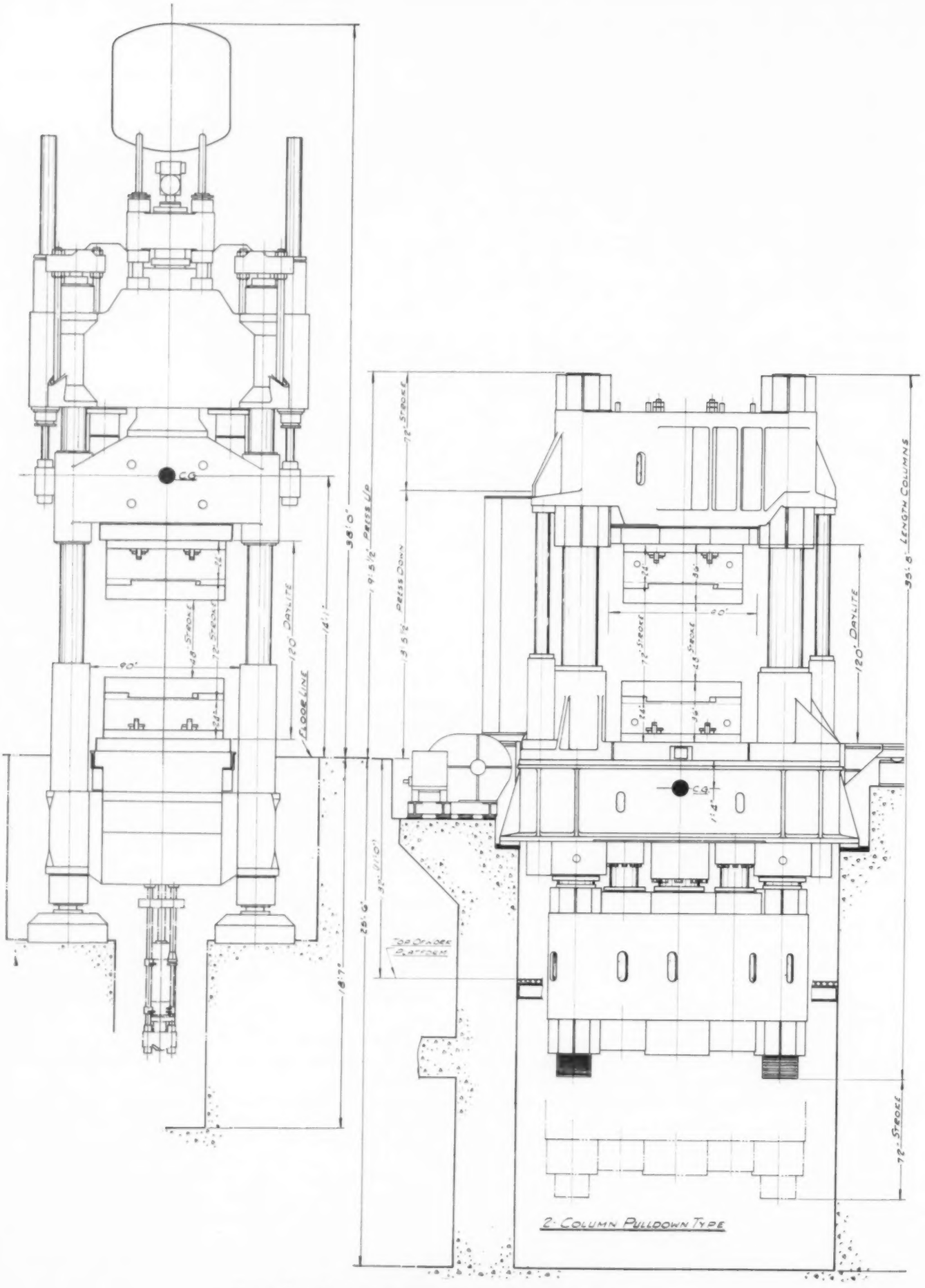


Figure 2 — General arrangement of 2000-ton forging press.

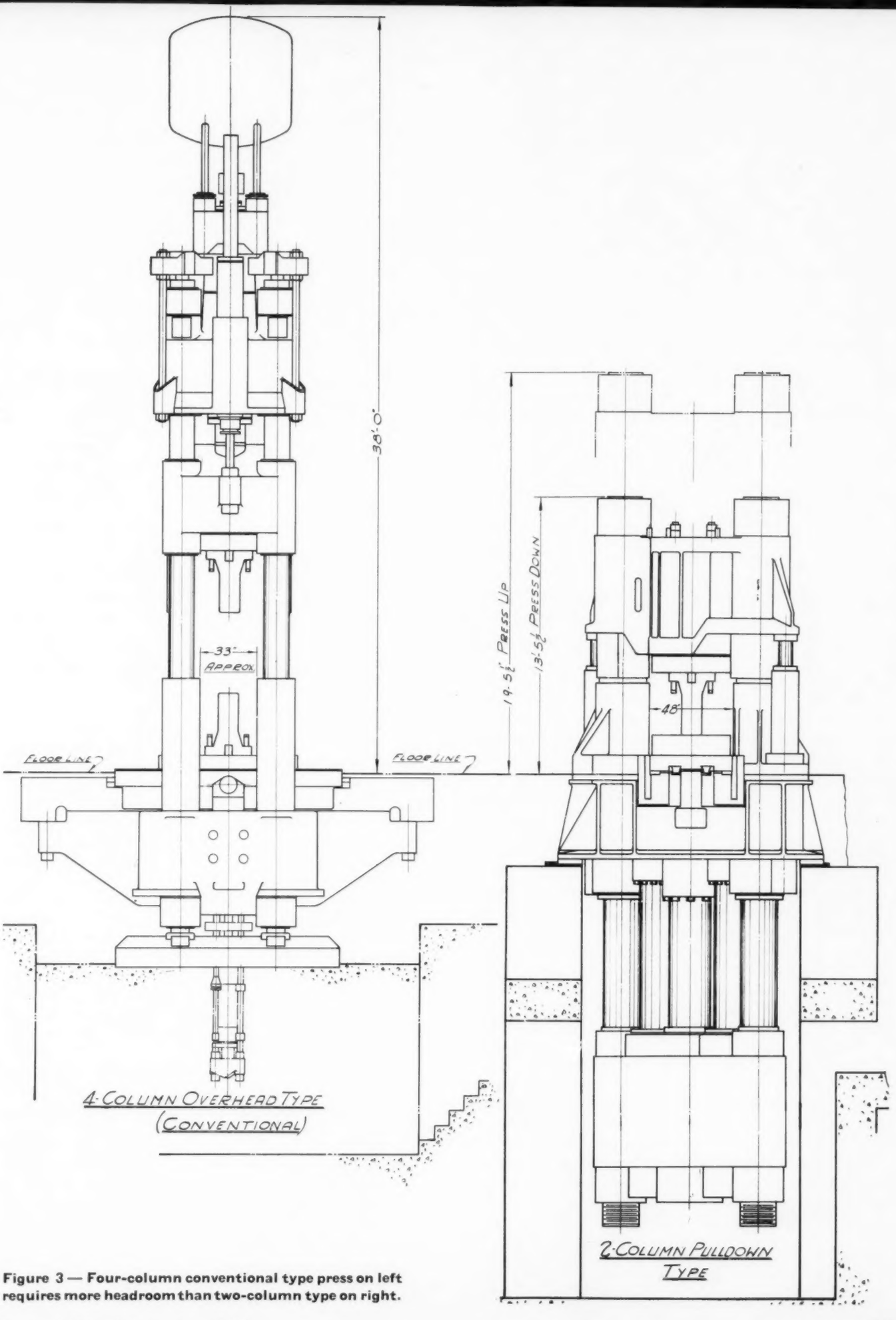


Figure 3 — Four-column conventional type press on left requires more headroom than two-column type on right.

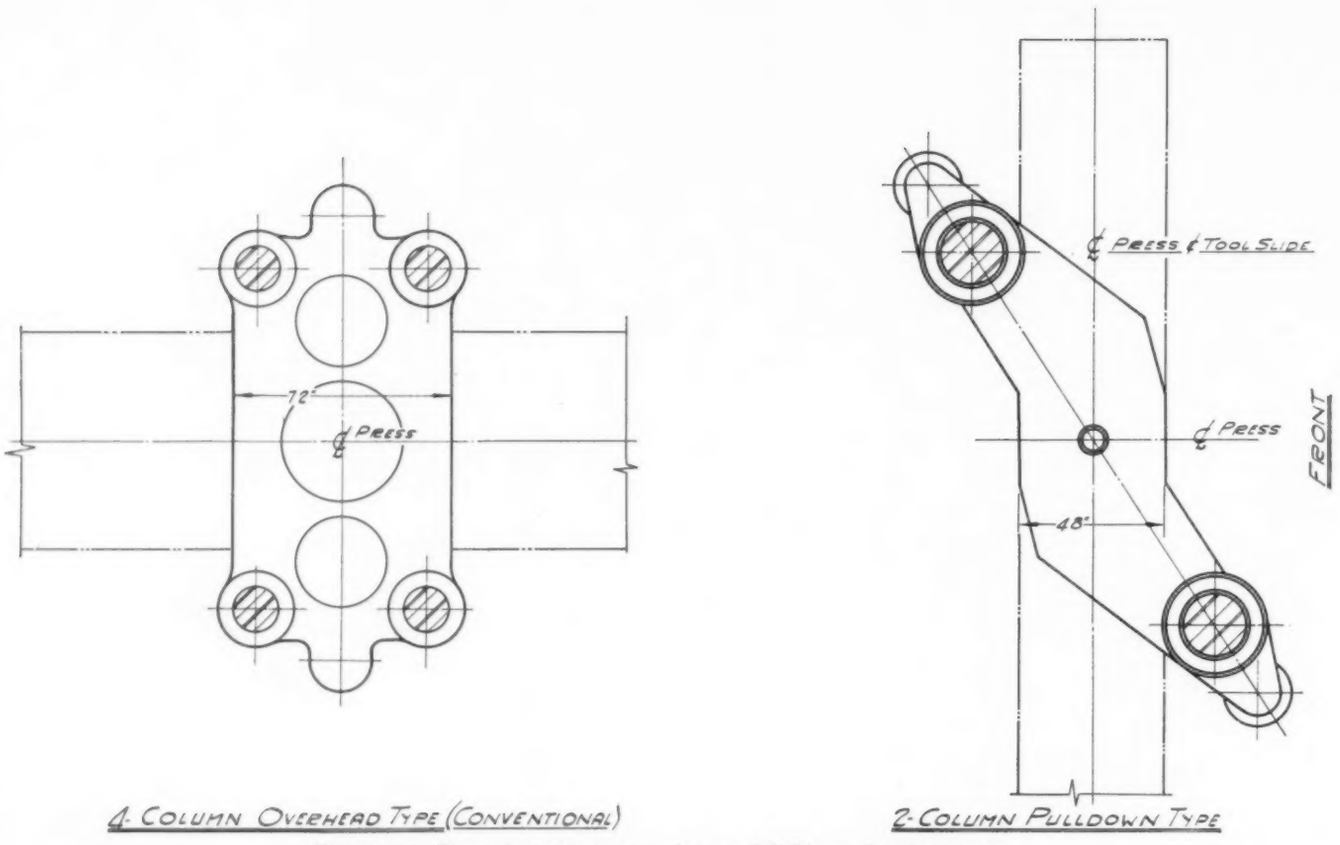


Figure 4 — Plan view shows top platen of 2000-ton forging press.

TWO-COLUMN TYPE

A two-column principle, as applied to the pull-down type press, offers an unobstructed view for the press operator. Having the dies fully exposed, the operator can place the work more accurately and concentrate more on the efficient use of the press and the manipulator. A charging machine and manipulator have an easy access to the press. A simple motion of the charging machine is all that is required to place or remove the forging into or away from the dies—the fourth column being eliminated from the corner of the press.

Wear of the column bushings is considerably less at the two-column pull-down press than with the conventional press, mainly because of the long guides.

The two columns, located diagonally make the right to left tool slide arrangement possible and expedient. The very narrow top platen provides very close access for the forging block.

The two columns, as compared with the four columns of equivalent cross-sectional area, provide more stiffness in bending under eccentric loading conditions. This is especially true when the four columns are flexibly mounted in the top platen, i.e., without the bottom nut.

It is very unlikely that the two column pairs of conventional design would take equal share of lateral reactions in case of eccentric loading, primarily as a result of unequal wear in the bushings.

One 21-in. diam column for instance is equivalent in area to two 15-in. diam columns, but the section modulus for bending of a 21-in. diam column is approximately 30 per cent higher than that of the two 15-in. diam columns combined; thus one 21-in. diam column is approximately equivalent to two 17-in. diam columns as far as bending stiffness is concerned, being considerably lighter at the same time.

The two-column pull-down design offers efficient weight distribution. The weight is put into the members where it can be utilized the most. In general, there is considerably more weight put into the press than into the drive unit. This ratio is approximately 5:1 on the press being discussed. The weight distribution in a conventional overhead four-column type with an air accumulator system is, by far, not as efficient since accumulators and pumps weigh considerably more than the direct drive.

Since the tool slide of the two-column pull-down press extends from right to left, it is easier to go over from ring to sleeve forging by merely turning the work 90 degrees and placing the jack stands on the long side of the tool slide without changing the upper dies. With conventional, four-column press, however, the tool slide extends from front to back, and therefore the die change is necessary to go from ring to sleeve forging operation.

In order to provide supports for the jack stands, the bottom platen of a conventional press has to extend on both sides, front to back, just for this purpose, without contributing much to the rigidity of the press proper. At the same time the wide base of the two column pull-down type press is part of the press proper in its full length and widths and because of that it also serves the purpose of supporting the jack stands.

TOOL SLIDE

An important part of the press operation is the tool slide. It enables the operator to change the tools

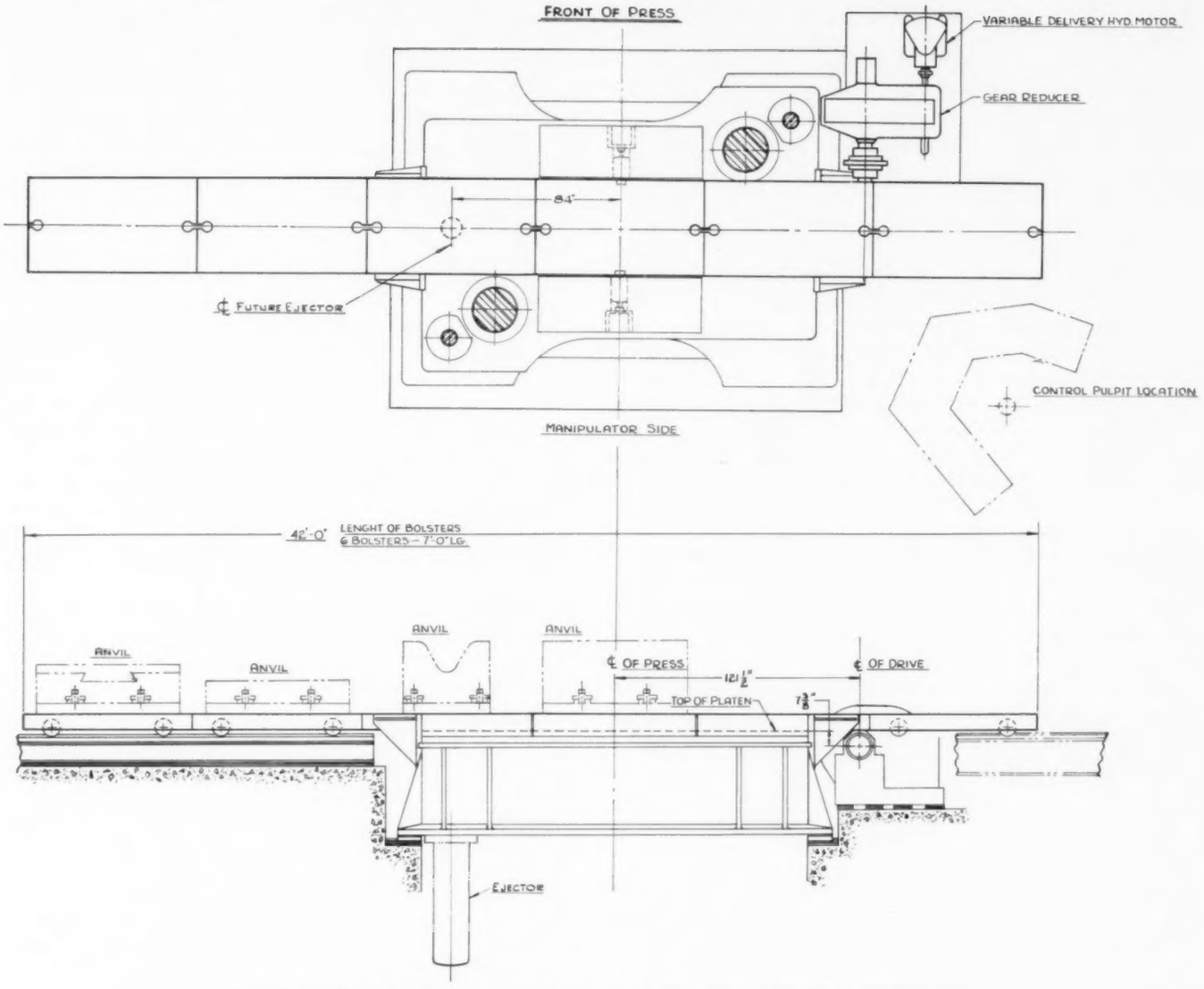


Figure 5 — Tool slide consists of six interchangeable units coupled together.

without any delay. Figure 5 shows the tool slide of the 2000-ton pull-down type press, consisting of six 7-ft long x 4-ft wide interchangeable units coupled together, one of them being a drive member and spare at the same time, and driven through a rack and gear pinion, gear reducer, and variable displacement hydraulic motor. Each slide is equipped with four wheels on anti-friction bearings, to roll on rails outside of the press bed. While on the press bed, slides transmit the load through heavy liners with wheels hanging free.

For positive alinement in the press, the individual slide is centered and locked in position by means of two air-operated locks, which are protected by heavy bolsters.

PRESS DRIVE

The direct drive, in contrast to the air-hydraulic accumulator system, offers power absorbed proportional to the resistance being met. Upon contacting the work, the temperature of the material decreases and the contact area increases, requiring more force to produce a constant rate of displacement. In addition, chemical and physical properties as well as manipulator bite may vary causing variations in resistance of the piece to be overcome. In the case of an accumulator drive, fluid pressure decreases as the stroke progresses due to pressure drop in the vessels. Therefore a constant rate of displacement at normally increasing resistance is not obtainable. Direct drive also offers constant speed of penetration during the entire pressing stroke and full capacity. With air accumulator drive, however, maximum depth of penetration at one stroke is limited by the capacity of the accumulator. While the air accumulator drive was popular in the last ten to fifteen years, the direct drive has found more and more application recently.

The direct drive may be used equally well with single, double, or triple-cylinder presses, for there is no need to provide pressure stages by cylinder selection. Relatively few forging presses have been operated by direct-oil pump drive in recent years. The pump capacity for the direct press drive is based on the maximum pressing speed at the maximum tonnages rather than on the mean water demand, such as is the case of air hydraulic accumulator drives. Therefore the pumps are the controlling factor in selecting the type of drive for high tonnages and fast speeds, assuming such fast speeds are a realistic desire.

In some instances it is advisable to use flywheels to overload the motors for short periods, thereby keeping

down the drive size. The necessity of adding accumulators in the form of flywheels, only slightly offsets some of the advantages of the direct drive. One of the main disadvantages of the air-hydraulic accumulators is constant head, against which the pumps have to work regardless of resistance. It is not economically feasible to regulate the pressure to meet the forging resistance other than through pressure stages. In the event that there are no pressure stages available and the press is required to work at a power considerably below its rated capacity, speed control implies throttling of the control valve, thus resulting in heat generation and waste of power.

Air-loaded as well as weight-loaded accumulator drives require excessive over-all heights and necessary heavy weights, as well as heavy foundations. The pump delivery with air-loaded accumulator is based on the mean demand of the period of working and not on peak requirements, to result in economical use of the press at its rated tonnage. Central accumulator stations for more than one press can be used. Higher forging speeds are obtainable for short time intervals. When used in connection with a three cylinder press design, accumulator drives provide three stages for the press operation. Air accumulator drives usually require a net of complicated piping which is continuously under full pressure making careful maintenance *a must* in order to insure efficient and safe operation of the installation. Leaky control spindles often cause great pressure and water losses.

On the contrary, the direct drive as applied to the pull-down type press described, represents a very compact unit which can be located in the basement close to the press cylinder with short connections to the press, rather than in a separate motor room occupying building floor space. Another advantage of the drive being installed in the basement is to keep down the noise level generated by the electric motors and hydraulic components.

After depressing the "stop" button at the control pulpit the entire hydraulic system is relieved from high pressures.

Readiness of the press for operation, with direct drive, is of advantage particularly when compared with a steam hydraulic intensifier driven press where the necessity of generating steam long before the actual forging takes place and the lack of sensitive controls makes the latter installations less flexible.

Running costs—that is kwhr consumed per average operating hour—at direct drive appear to be considerably lower than those for air or weight-loaded hydraulic accumulators under general conditions.

When oil is used as working fluid, pumps running at 850 to 1800 rpm, directly connected to the electric motor, represent a very compact design and therefore require considerably less space than triple-plunger water pumps. The oil valves are also easier to control and are more compact than water valves. Cavitation damage is likely to be negligible as compared with water. Wear is also minimized with oil.

Where the oil drives are physically separated from the press and the press cylinders are located under the floor, as is the case with this pull-down type presses, the danger of fire is minimized. The most advantageous pressure on direct drive appears to be at approximately 5000 psi, while at the same time, the optimum pressure for air hydraulic accumulator seems to be between 3500 to 4500. The high working pressure results in smaller pipe and valve sizes, as well as reducing the amount of liquid necessary for each power stroke.

Considering the initial installation cost, the oil drive also holds its own with the accumulator drive.

A simplified hydraulic circuit of the press is used. Hydraulic pressure in the range of 4500 psi was selected due to its being the most economical and efficient in the design of presses of large capacity. Twenty constant delivery axial piston type pumps of 35 gpm each, driven by double ended electric motors, 150 hp, 1200 rpm each, were selected as the power unit.

The motor pump assembly for the ten units used for driving the press are built with a manifold as an integral part of the unit. Each unit carries its own relief valve and check valve subplate, mounted on the manifold. Ten of the pump units also carry their own unloading valves. These valves are controlled by solenoids which permit the venting of the individual relief valves which unload the pumps. A selector switch is provided at the pulpit to permit the operator to select the desired pressing speed. The use of the multiple units permits speed variation in increments of 5 per cent. Only one motor pump assembly is enough to carry as a spare unit.

Conforming with our designs, this press is provided with two large manifold blocks on which all of the main operating valves are mounted. The inlet and exhaust manifold assemblies are mounted on the opposite side of the press close to the press cylinders, resulting in continuous flow with better cooling of the pressure fluid and slushing of any dirt deposits. Manifolding of the multiple standard valves eliminates a great deal of piping and flange connections. The compact and rigid construction of the manifold assembly simplifies maintenance and replacement. The use of multiple small standard valves instead of a single large one cuts the shifting time considerably, and provides smooth reversals by damping the effects of shock and turbulence, thus eliminating pipe breakage due to pressure surges. A misfunction of one or more of the operating valves, or even one of the pump units does not interfere with the operation of the press, yet can easily be detected and corrected.

A separate pilot system is used to provide the power for shifting the valves. This pilot system is designed to operate in the range of 800 psi. A small accumulator bottle is used to furnish the instantaneous demand of oil required to permit as many as fifteen valves to shift simultaneously in one-tenth of a second. The pilot pumps consist of a small 1000-psi pump and a 2000-psi pump, driven by a 60-hp motor. The 2000-psi pump is used also to operate the die slide.

A low pressure system is also used to prefill the center cylinder. This system has its own level controls which keep the tank at the proper level. A 3-hp pumping unit is used to transfer oil from the main oil reservoir into the pressurized tank when required.

The circuit is designed for two methods of operation; namely, forging and planishing. This selection is available by turning a selector switch on the panel. The planishing cycle permits faster stroking at reduced tonnage and stroke.

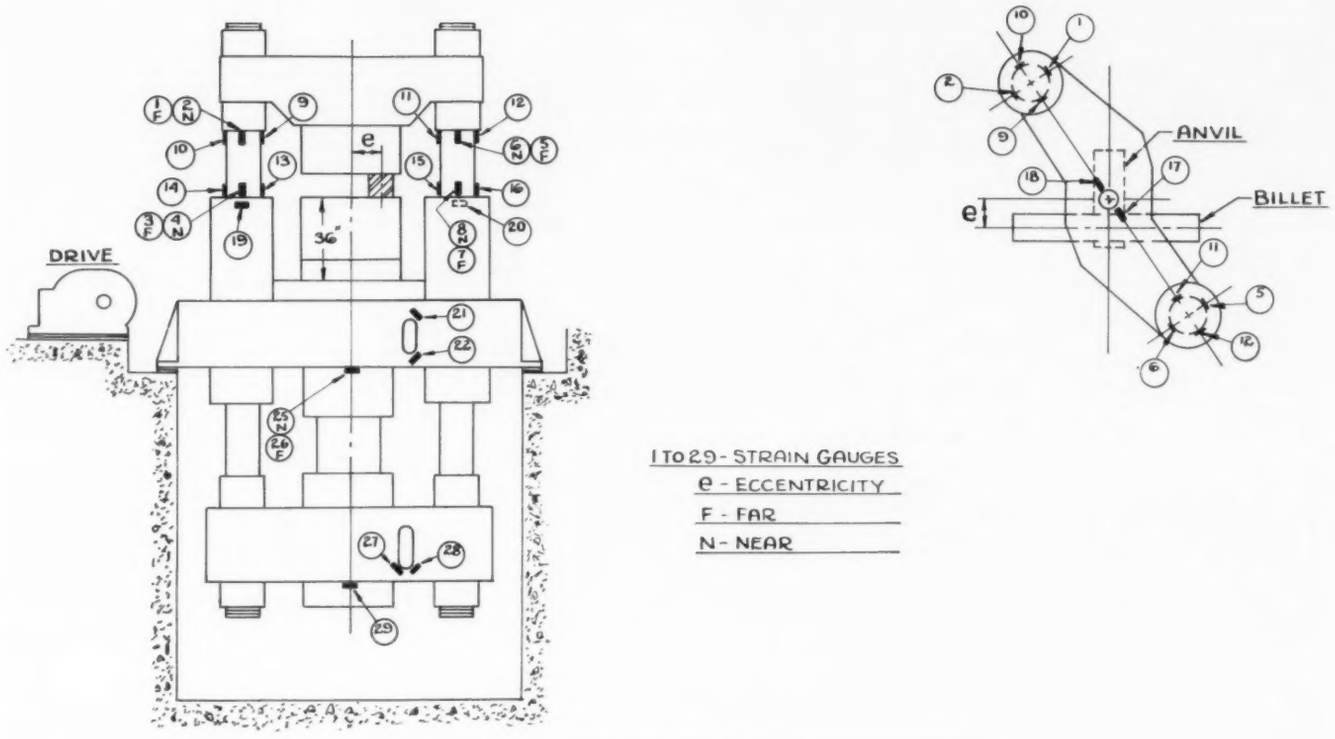


Figure 6 — Strain gages were applied to measure stresses.

When set for planishing cycle the volume of all twenty high pressure pumps is directed to the two outer main cylinders and to the pushback cylinders. As the crosshead is forced down, the center cylinder is filled with oil from the low pressure tank. In this cycle, the center cylinder does not receive high pressure oil as only the outside cylinders are used. The constant pressure pushbacks act much the same as a spring, causing the crosshead to return by merely opening the exhaust valves, thereby insuring instantaneous response, as no time is required for pressure build-up in these to effect immediate reversal. Therefore, by opening and closing the exhaust valves, the press moves rapidly up and down. The volume of ten pumps is unloaded when the crosshead is returning, while the volume of the other ten pumps is kept constantly coming into the circuit. The reversal is accomplished by pressure or position, whichever one is desired, or whichever occurs first.

The forging cycle is the same as planishing during the downward motion of the crosshead. However, when the resistance of the work can no longer be overcome by the two side cylinders, the oil is automatically sequenced into the center cylinder. Prior to this step, however, the filling valve of the center cylinder is closed and the pushback rams are exhausted. This permits the moving weights, in addition to the hydraulic pressure on all three rams to be effective on the work.

When either a preselected pressure or limit switch is contacted, an electrical signal opens a valve which decompresses all three cylinders. When the pressure drops to the setting of a pressure switch, the filling valve of the center cylinder is opened and the volume of ten pumps is directed to the pushback cylinders. The oil from the center cylinder is exhausted out of the filling valve, which is now acting as an exhaust valve, into the low pressure tank. The oil from the side cylinders is exhausted through a bank of manifolded exhaust valves into the main oil reservoir. The pressure exerted on the side and main cylinders, and the shift-over pressure from two to three rams, is all independently adjustable.

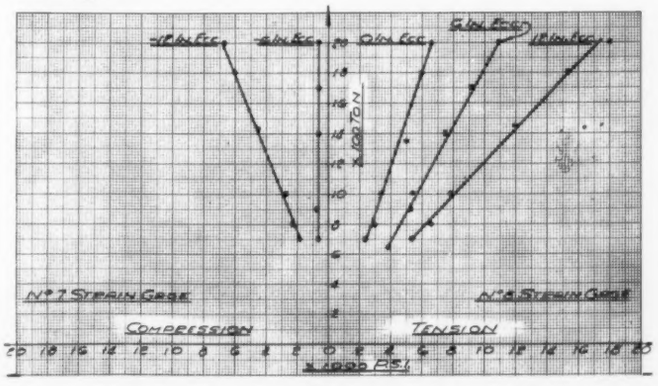
The oil from the 2000-psi pilot pump is used to drive a hydraulic variable displacement motor which, in turn, operates the die slide through a gear train. A lever at the operator's pulpit is used to accomplish this action when desired.

A 5-hp constant delivery pumping unit circulates the oil through two multi-pass coolers and oil filters, to provide the necessary cooling for the entire system.

PRESS CONTROLS

It is important, in forging presses that the operator has sensitive and positive control over the press movements. At the same time, it is also important that the operator is not exposed to fatigue by moving a control lever back and forth continuously, and he therefore can concentrate on the forging and co-ordination of the press and manipulator functions. Even the best

Figure 7 — Stresses are those in column under eccentric loading.



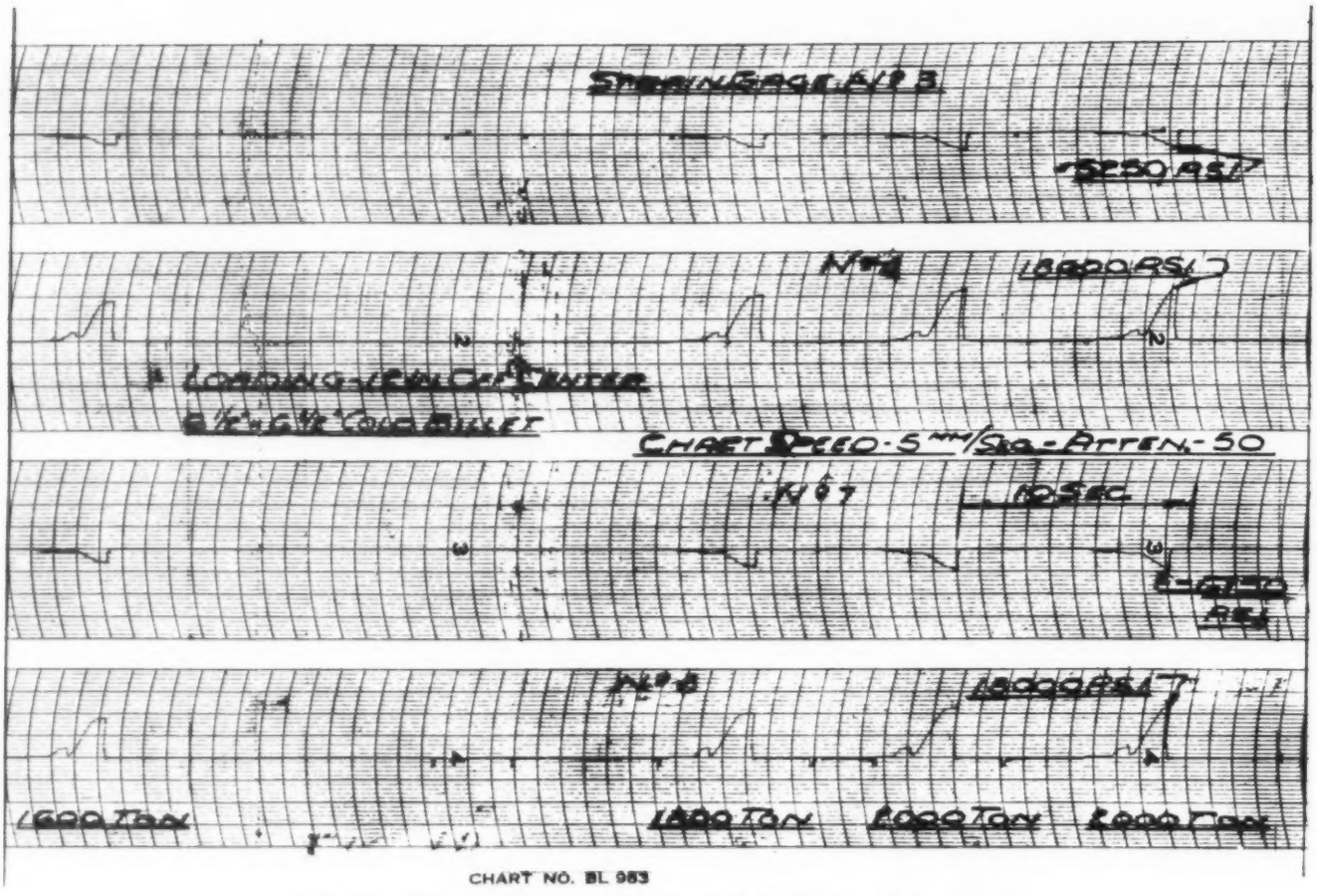
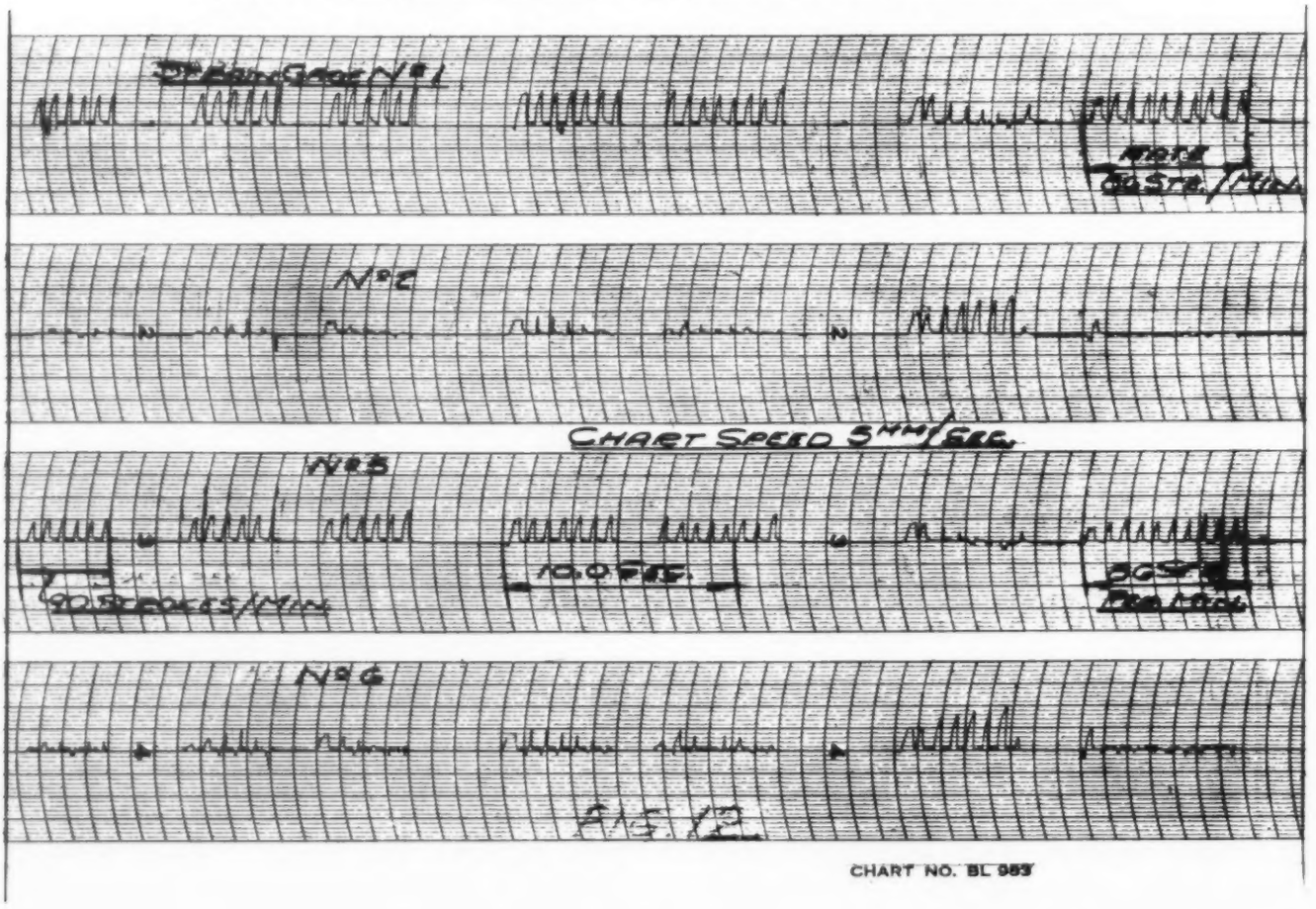


Figure 8 — Oscillograph gives typical recordings of surface stress.

Figure 9 — Oscillograph gives readings of stress when press is set at automatic cycling.



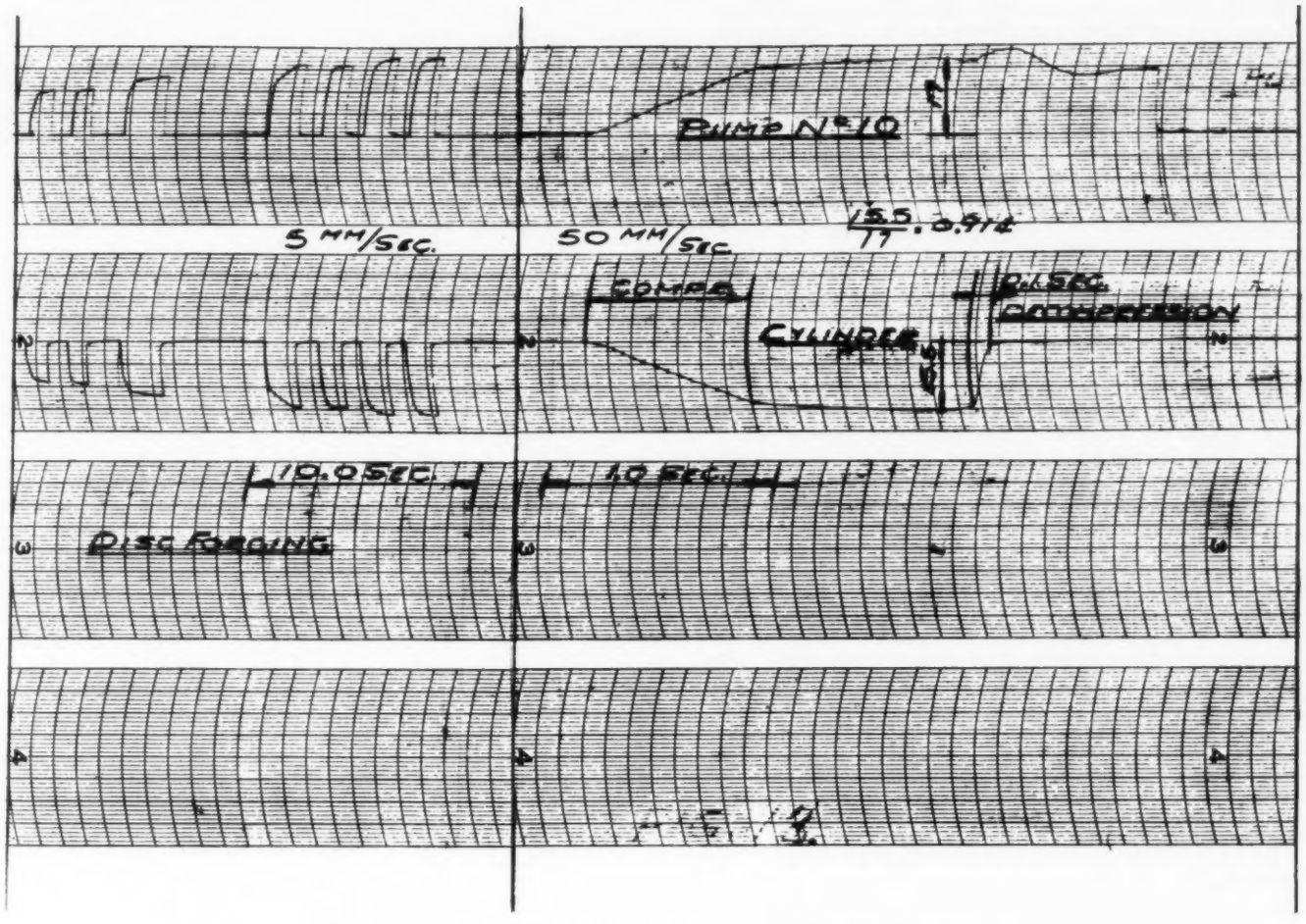


Figure 10 — Chart shows pressure curves for individual cycles.

servo-control lever will tire the man if it has to be moved 100 to 120 times a minute for any long period of time. A high speed built into the press is of little value, if it cannot be efficiently utilized. Therefore special emphasis was put on the over-all speeding up of the forging cycle rather than concentrate on increasing individual speeds only, without considering the handling time of the forging.

The press is equipped with pushbutton controls, necessary to perform the jogging, single stroke and full automatic operation at reduced (side cylinder only) or full (all cylinders) tonnage, with automatic reversal by position or pressure, with the pressing speed preselected by the operator.

An important feature of the press control is the ability to forge to a preselected position. Two independent pairs of motorized working limit switches are provided along with the selector switch for determining which pair is to be used. Thus one pair can be set up for working on each side of the rectangular billet in advance without the operator having to readjust limit switches in the middle of the forging or planishing operations.

A maximum return limit switch is also provided. At no time during forging does the operator have to leave the pulpit for the purpose of adjusting the stroke controls. A so-called zeroing mechanism is incorporated in the stroke control assembly to compensate for the different heights of the dies.

This type of remote position control results in better accuracy of finished product, it offers dependable, consistant and repetitive automatic action, it minimizes human error, and requires far less skill of the operator. Penetration speed reduces itself automatically to zero from a preselected value at the correct position of the tools. The direct position control allows the operator to operate the press at maximum speed during the entire cycle.

Position controls may be applied to manipulator functions as well.

Next possible step in the development of position controls of a future press, may very well lead to an automatic programming and punch card system. Over-travel of the press, at the present time, can only be estimated empirically, this being constant for given conditions.

For pressure and corresponding tonnage controls of the press operations, separate calibrated handwheel controls are provided on the pulpit for the side rams (planish) and for all rams (forge). A multi-position selector switch for preselecting the closing and pressing speed and not affecting the return speeds of the press is also located on the pulpit. All press, manipulator and auxiliary equipment controls are arranged in a manner convenient to the operator, reducing his fatigue; thus increasing efficiency.

Customer had arranged for floor-operated remote control of the forging manipulator and since the press controls could be worked into a single arrangement, they were merely incorporated into the manipulator pulpit, rather than in a separate control stand.

TABLE II

Column stresses at the column guides are computed from surface strains, measured simultaneously by SR-4 strain gages under eccentric loading conditions.
Test Billet: 6½ x 6½ in. cold
Anvils: 30 in. long x 35 in. high x 12 in. wide

Type of loading			Stress, psi			
Eccentricity, in.		Load, ton	Strain gage			
F-B	R-L		No. 3	No. 4	No. 7	No. 8
3 approx.	0	700	900	2400	450	2400
		800	1200	3000	900	3000
		1000	1800	3300	1300	3400
		1350	2900	4400	2100	4500
		1800	3900	6000	3300	6000
		2000	4500	6600	4200	6600
	6	650	− 300	3900	− 600	3900
		900	− 400	5200	− 680	5300
		1050	− 300	5400	− 300	5400
		1400	600	7200	− 600	7500
		1700	900	9000	− 600	9200
		2000	1150	10500	− 600	10900
	12	700	−1500	5100	−1800	5400
		800	−1800	6300	−2300	6600
		1000	−2000	7800	−2700	7800
		1425	−3000	12000	−4500	12000
		1800	−4500	15400	−6000	15400
		2000	−5250	18000	−6750	18000

FIELD MEASUREMENTS OF THE SURFACE STRAINS

Since neither mechanical nor hydraulic devices are provided to take the effects of the eccentric loading conditions, the press proper has to absorb all the moments created by the off-center loads. Press members therefore must be rigid enough to withstand the load applied eccentrically. In view of the fact that this press is of a rather unique design and embodies a redundant structure in form of a sliding frame, actual tests were performed for determining stresses at various points, to verify design computations. Figure 6 shows the positioning of the strain gages on the various press components.

The stresses were determined by measuring the surface strains experimentally. SR-4 wire resistance strain gages were used in connection with four amplifiers and a multi-channel oscillograph for direct recording of strains. Particular attention was given to the press columns under various loading conditions. Static, as well as dynamic tests under actual operating conditions were carried out in the forge shop.

Figure 7 shows the stress distribution of the column in the plane perpendicular to the centerline of the press frame under different eccentric loading conditions. When full load of 2000 tons was applied at 12 in. off-center, the gage No. 8 indicated maximum strain, which is equivalent to 18,000 psi combined stress.

The calculated direct tensile stress of the column closer to the load applied is 6700 psi. Thus the maximum bending stress found is 11,300 psi. On the opposite side of the column, gage No. 7 indicated strain equivalent to 6750 psi compression under the same off-center loading.

Stresses at the corresponding points of the second column were computed from the strains of gages No. 3 and 4. The stress distribution pattern is very similar to the one shown in Figure 7 and is tabulated in Table II.

Figure 8 shows a typical, simultaneous oscillograph recording of the strain gages No. 3, 4, 7 and 8 at different loads applied 12 in. off-center on a 6½- x 6½-in. cold billet.

Strains at the corresponding points of the column under the bottom nuts of the top crosshead were measured as well, with gages No. 1, 2, 5 and 6, and results tabulated in Table III. Since the column is clamped tightly by the nut ahead of the thread, the root diameter of which is bigger than the net column diameter, it is reasonable to assume that the strains at the start of the thread do not differ substantially from those measured by gages No. 1, 2, 5 and 6. It was found that the stresses directly under the nut were approximately of the same magnitude as those measured 24 in. away on the column (gages 3, 4, 7 and 8), under the same loading configuration.

Figure 9 indicates the strains of the gages 1, 2, 5 and 6 while the press was set on automatic cycling for planishing of hot billet placed approximately in the center of the press. It is evident from this graph that the press was cycling at the rate up to 90 strokes per min with 2½-in. stroke.

Table IV shows stresses as per gages 9, 10, 13 and 14 at full tonnage applied concentrically. The fact that gages 9 and 13 show higher strains, indicates that the columns under load deflect towards the center of the press, while the rigid corners of the statically indeterminate frame are preserved.

Strains on several other points of the press were

TABLE III

Column stresses under the nuts are computed from surface strains, measured simultaneously by strain gages under eccentric loading conditions.
Test billet: 6½ x 6½ in. cold
Anvils: 30 in. long x 35 in. high x 12 in. wide

Type of loading			Stress, psi			
Eccentricity, in.		Load, ton	Strain gage			
F-B	R-L		No. 1	No. 2	No. 5	No. 6
3 approx.	0	1500	5100	4200	4000	4500
		2000	6600	5700	5600	5800
	6	1400	600	9000	− 650	9000
		2000	1200	12400	− 750	12000
	12	1000	−1800	9000	−2100	9000
		1400	−3000	12000	−3300	12000

TABLE IV

Column stresses computed from surface strains, measured by strain gages under concentric loads on solid anvils (30 x 35 x 12 in.).

SR-4 gage no.	Load, ton	Stress, psi
9	1800	7100
	2100	8300
10	1800	5700
	2100	6300
13	500	1800
	800	3900
	2000	6150
14	500	1800
	800	3300
	2000	5100

TABLE V

Hydraulic Circuit Efficiency Test Data

Two pressure cells used as pressure pickups in connection with multichannel oscillograph and amplifiers. Test performed while forging ingot 19 x 19 in., 7000 lb Allegheny Ludlum grade 82 steel.

Test pump no. 11 and side cylinders

	15 Pumps operating			20 Pumps operating		
	Pump	Side cylinder	Efficiency	Pump	Side cylinder	Efficiency
Tonnage at the pulpit	Chart graduation	Chart graduation	Per cent	Chart graduation	Chart graduation	Per cent
1200	10.5	9.5	90.5	10.0	9.0	90.0
1250	10.5	9.75	93.0	10.75	9.75	90.6
1400	11.75	10.75	92.0	12.0	11.0	92.0
1450	12.5	11.5	92.2	12.75	11.5	90.2
1500	12.75	11.75	92.6	13.1	11.75	90.0
1600	14.25	13.0	91.4	14	13	93.0
1600	14.00	13.0	93.0	14	13	93.0
1700	14.1	13.1	93.2	14.5	13.1	90.5
1800	15.2	14.1	92.7	15	14	93.6
1850	16.0	14.80	92.6	16	15.0	94.0
1940	...	...	...	17	15.5	91.3
2060	...	...	...	18	16.75	93.4

measured and the stresses computed, while the press was forging different grades of alloy steel.

PERFORMANCE TESTS FOR DETERMINATION OF THE HYDRAULIC EFFICIENCY OF THE PRESS CIRCUIT

Hydraulic efficiency tests of the press circuit were also carried out under operating conditions in the forge shop. This efficiency is defined as the ratio of the effective pressure in the press cylinders at the rated speed to the pressure developed at the discharge side of the pumps.

Two resistance wire strain gage type pressure cells were used as pressure pickup in connection with multichannel oscillograph and amplifiers. At first the two pressure cells were connected to the discharge side of one of the twenty pumps and calibrated to obtain the same sensitivity. Then one of the two pressure pick-ups was connected to the press cylinder while the other remained at the pump. In this manner a relative, but accurate, difference between the two outputs was recorded on the oscillograph at various tonnages and speeds. The graphs were evaluated and some of the data tabulated in Table V, which indicates that the hydraulic efficiency of the circuit ranges between 90 and 94 per cent.

As is our standard practice while designing the hydraulic circuit, an attempt was made to keep the pipelines as short as possible. Bends and other restrictions were avoided wherever possible. Line velocities were generally kept under twenty fps.

The operating, decompression and prefill valves are mounted close to the cylinders thus keeping to a minimum the amount of oil to be compressed and decompressed, eliminating long pipe connections and resulting in an instantaneous rate of decompression. The decompression time was measured as being in the order of 0.10 sec. Figure 10 shows the pressure curves at the pump and press cylinder for individual cycles at the two different oscillograph-chart speeds.

The smooth pressure build-up in the cylinder during work stroke is almost identical with that at the pump. The time of the pressure build-up includes the compression of the oil, stretch of the press members as well as upsetting of the work at low tonnage. It is evident from this graph that the pressure build-up in the cylinder is directly proportional to the resistance met. At the end of a pressure stroke, an instantaneous decompression takes place in the cylinder, while at the same time, the pressure at the pump increases slightly to overcome the inertia of the moving press members to be reversed—the pushback cylinders being under constant pressure.

It was also found experimentally that certain alloy steels will not respond to the fast penetration speeds. Evidently a finite time is required to displace the internal structure of certain materials. While forging a 19-in. x 19-in. steel ingot-grade 82—the work was deformed faster with fifteen pumps operating than with twenty pumps. An accurate control of penetration speed is therefore a very important inherent feature of the direct drive of this newest forging press development. ▲

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A difficult question which the maintenance man must answer is when are ropes worn to the point where they should be changed . . . . changing too early is uneconomical, changing too late may result in accidents . . . . a semi-empirical procedure outlined in this paper will help solve this problem.

WHEN DO YOU CHANGE WIRE

by J. E. Grimwood
Sales Representative
John A. Roebling's Sons Corp.
Pittsburgh, Pa.

THE term "wire rope cables" covers the entire field of wire rope applications, but for the purpose of this discussion is limited to crane cables. Crane cables can be divided into two groups: those that operate indoors such as overhead cranes, and those that operate out in the weather such as rigging cranes, locomotive cranes and excavating cranes.

Overhead crane ropes are normally a 6 x 37 construction, with either a fiber or an independent wire rope core. Rigging and excavating cranes usually use a 6 x 19 construction, although a 6 x 37 construction may be used depending on the conditions.

The life cycle of these ropes is the same and consists of installation, maintenance, inspection and removal from service. Each phase of this cycle is important and has a definite bearing on the ultimate life of the rope.

Installation—Before a new rope is installed, the equipment—sheaves and drums—should be checked. Sheave and drum grooves should have the proper clearance for new rope and no broken flanges, sharp edges or corrugations that would cause excessive wear. When installing wire rope, great care should be exercised in removing from the coil or reel. If in the form of a coil, the free end of the rope should be laid on the floor and the coil placed on edge to unroll it. A reel can be supported by a pipe or bar through the center hole and the rope pulled off. Improper practices in uncoiling or unreeling produce a spiral condition in the rope which is very difficult to remove. This condition often leads to kinks which cause permanent damage to the rope.

Maintenance—Since wire rope, is a complex and precision piece of machinery, proper maintenance is essential to obtain maximum service. Fatigue, abrasion and corrosion are the prime causes of rope failure. Fatigue, which is caused by bending, cannot be eliminated but it can be held to a minimum. The removal of flat sheaves or ones with excessive play may reduce whipping considerably as well as the resultant fatigue. When a differential sheave is encountered, cutting from one end of the drum moves the points of greatest fatigue and often prevents a premature failure. Abrasion, provided the sheaves and the drum are in good condition, can best be combatted by proper lubrication. Lubrication is highly important, not only in reducing abrasion and preventing corrosion but, also, by reducing both wear and friction within the rope itself. Corrosion should be guarded against continually because under these conditions it is impossible to calculate or estimate the remaining strength of a rope.

In respect to lubrication, it is interesting to note the results of tests made in our laboratory on $\frac{9}{16}$-in. diam 6 x 19 wire rope submitted to fatigue tests. Part of this rope was laid up with and part without lubricant. Samples of each section were operated over sheaves of two different diameters until the same number of broken wires in a given length developed. The following comparison shows the results based on the number of bends necessary to produce these broken wires.

	10-in. tread diam sheave	*24-in. tread diam sheave*
Dry rope	16,000 bends = 2.4 times	74,000 bends = 4.6 times
Lubricated rope	38,700 bends = 5.2 times	386,000 bends = 10.0 times

In view of the above figures, the reasons for stressing lubrication as well as the proper sheave sizes are quite obvious.

Inspection and removal from service—Once a rope has been placed in service, it is subjected to varying operating conditions which ultimately reduce its strength and require its replacement. As the condition of the rope is constantly changing, inspections are necessary at periodic intervals to record its condition. Primarily, the purpose of the inspection is to compare the present condition of the rope to its condition when new. The job of the inspector, either by experienced judgment or by some definite procedure, is to estimate the remaining strength of the rope and thus determine the degree of safety being afforded at the same time. In this respect, it is important that the proper factor of safety be afforded for a new rope installation, and this factor should be determined consistent with safety and most economical rope life. Safety of operation depends upon the strength of the rope as it nears the time of removal. This margin—the true margin of safety—although difficult to determine, is a practical factor in setting the proper time for removal. Since the installation is no safer than the strength of the rope at the time of removal, it is necessary to establish a minimum factor of safety below which it is not advisable to operate.

ROPE CABLES?

Listed as follows are a few minimum safety factors which can be used as a guide, but not as an established practice.

Type of service	*Minimum safety factor*
Miscellaneous hoisting equipment	5.0
Haulage rope	6.0
Overhead and gantry crane	6.0
Jib and piller cranes	6.0
Derricks	6.0
Small electric and air hoists	7.0
Hot ladle cranes	8.0

While on the subject of safety factors, there is a recent development of high strength ropes which give a strength 15 per cent greater than improved plow steel grade. One of the many advantages of this type of rope is an increase in the initial factor of safety while retaining the same diameter of rope.

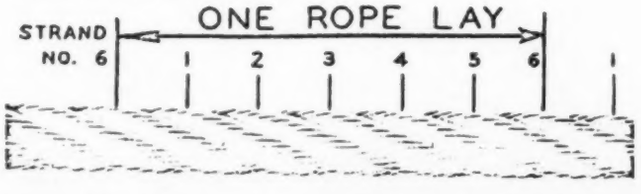
The decision as to the proper time for the removal of a wire rope from service is one of the most difficult problems that can be placed before the inspector or operating official. The establishment of a minimum factor of safety is up to the operating officials, determining when this condition has been reached is up to the inspector.

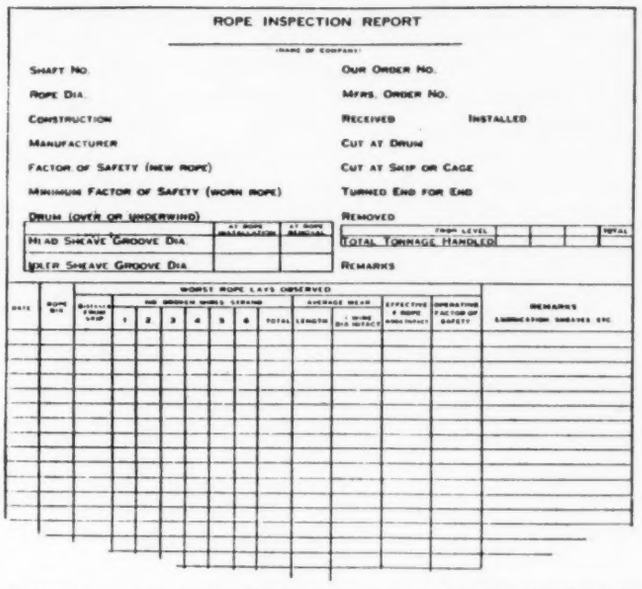
In general, the time for removal is indicated by a marked reduction in the diameter of the rope, excessive abrasion of the outside wires, broken outside wires or evidence of severe corrosion. These factors can be determined by visual inspection of the outside of the rope.

The marked reduction in the diameter of the rope is often due to excessive abrasion or corrosion of the outside wires, but, in some instances, it is due to excessive corrosion of the inside wires which is not indicated by a surface inspection of the rope. Internal deterioration is a serious and dangerous condition, and any marked reduction in the diameter of a rope should be investigated carefully and its cause determined.

Excessive abrasion can be observed on the outside wires and can be allowed for in calculating the remaining strength of the rope.

Figure 1 — A rope lay is the length of rope in which a strand makes one revolution.




ROPE INSPECTION REPORT

(NAME OF COMPANY)

SHAFT NO. — OUR ORDER NO.

ROPE DIA. — MFRS. ORDER NO.

CONSTRUCTION — RECEIVED — INSTALLED

MANUFACTURER — CUT AT DRUM

FACTOR OF SAFETY (NEW ROPE) — CUT AT SKIP OR CAGE

MINIMUM FACTOR OF SAFETY (WORN ROPE) — TURNED END FOR END

DRUM (OVER OR UNDERWIND) — REMOVED

	AT ROPE INSTALLATION	AT ROPE REMOVAL
HEAD SHEAVE GROOVE DIA.		
IDLER SHEAVE GROOVE DIA.		

FROM LEVEL — TOTAL

TOTAL TONNAGE HANDLED

REMARKS

WORST ROPE LAYS OBSERVED

DATE	ROPE NO.	DISTANCE FROM SHAFT	NO. BROKEN WIRES/STRAND 1	2	3	4	5	6	TOTAL	AVERAGE WEAR LENGTH	% WIRE DIA. WEAR	EFFECTIVE % ROPE AREA REMAINING	OPERATING FACTOR OF SAFETY	REMARKS (LUBRICATION, SHEAVES, ETC.)

Figure 2 — It is desirable to have a rope inspection report.

The broken wires can be counted, and their effect can be calculated, taking into account the number of broken wires occurring and their distribution among the various strands.

When corrosion is present, the remaining strength cannot be calculated with safety, nor is there any reasonable way to judge whether or not the rope is safe for further service, except by the judgment of the inspector who compares it with the condition of previous ropes on the same installation, but even this is a precarious method. When corrosion is present, all the known methods for estimating the remaining strength of wire rope become useless.

In setting up any procedure for the removal of wire rope, corrosion should be controlled and this can be done by proper and sufficient lubrication.

It is not possible in the following charts or in any chart development to indicate definitely the remaining strength for all conditions of service. These charts, however, together with actual ultimate strength tests on worn ropes from individual installations, make it possible to build up definite data for the particular installation from which the actual remaining strength of the rope can be judged. The number of broken wires which develop in a wire rope is the usual reason for removal. This is a definite indicator that should always be evident in visual inspection. There is always a section somewhere along the length of wire rope which visibly shows the greatest amount of deterioration. Experience has indicated that the condition of the worst rope lay is a safe guide for rope removal.

A rope lay (Figure 1) is that length of rope in which one strand makes one complete revolution around the core. The examination of such a section for abrasion and broken wires should—if it is the worst rope lay—give sufficient information to permit the calculation of effective remaining area.

In order to set up inspection data which can be used as a record, a suggested form is shown in Figure 2. This was designed for shaft hoist rope but shows essentially what should be recorded. Keeping accurate rope records is highly important in comparing rope service.

In addition to the data collected, a photograph of the

worst lay is often valuable to the inspector in comparing various conditions.

A safe inspection practice can be built up by setting up a minimum effective remaining area for one or two ropes and, after checking, by making ultimate strength tests, this minimum could be reduced if the tests so indicated. By using this procedure, the proper time for removal could be safely determined.

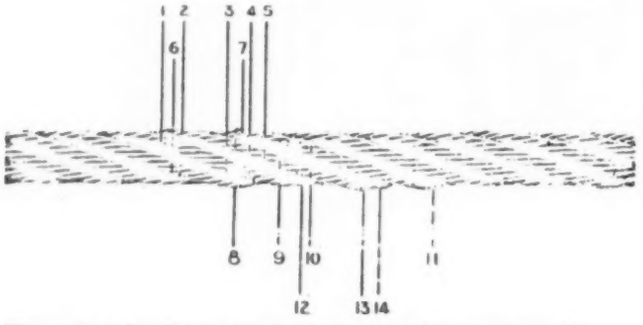


Figure 3 — Broken strands are counted in one rope lay.

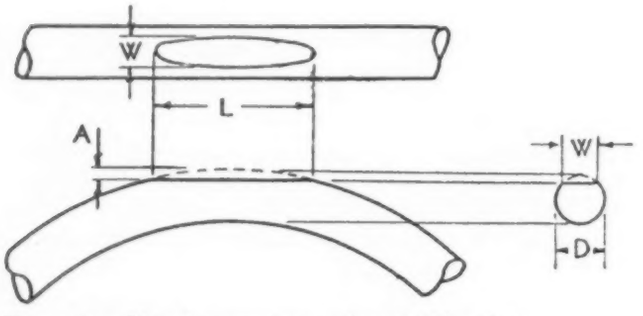
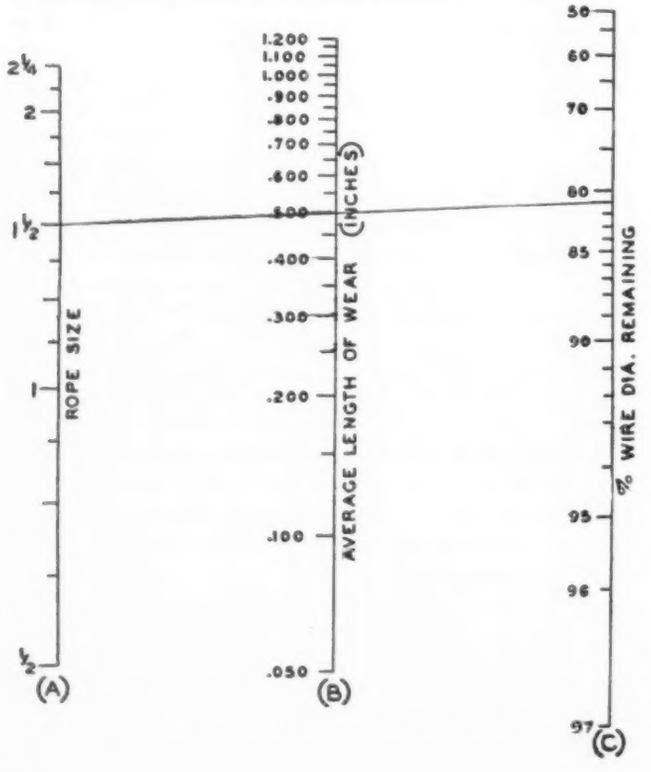


Figure 4 — Abrasion occurs on the outside wires.

Figure 5 — Nomograph gives depth of abrasion for 6 x 25 filler wire construction regular lay rope. Draw a straight line from rope size on scale *A* to the average length of wear on scale *B*. Intersection at scale *C* gives the percentage of the outside wire diameter which is left.



Charts for regular lay ropes—The purpose of using charts for the determining of the percentage of effective rope-area intact is to simplify the procedure and eliminate the laborious calculations involved. Primarily, the charts correlate the effects of broken wires, abrasion and distribution of breaks into effective rope-area intact. Due to the very numerous constructions involved, only the most commonly used have been worked up on a chart basis.

The following charts apply only to our companies regular lay hoisting ropes, 6 x 25 filler wire construction.

To use the charts, the broken wires in the worst lay of rope are counted by strands. See Figure 3.

The wear should be measured in this same section by measuring the length of the elliptical worn surfaces of the crowns of the outside wires, dimension "L" in Figure 4.

After this information has been obtained, Figures 5 and 6 can be used to determine the percentage of rope-area remaining intact.

Figure 7 is used for taking into account the distribution of broken wires in the strands, and the determination of the effective percentage of rope-area intact.

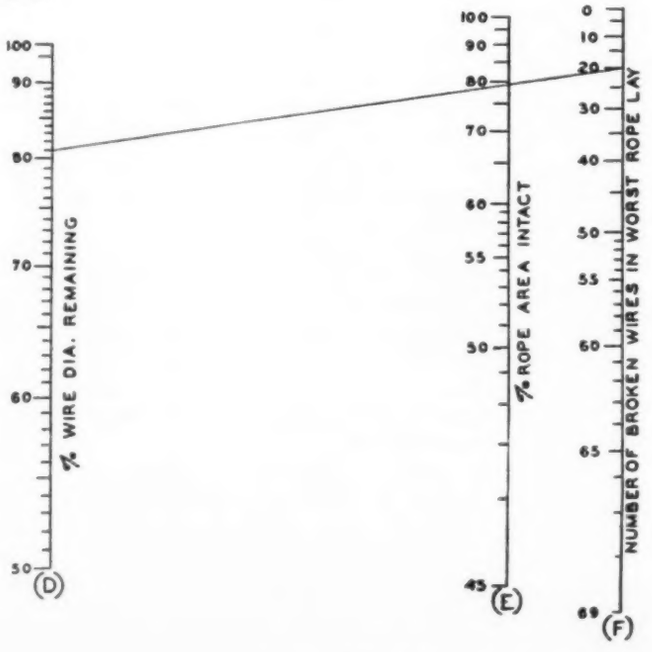
Figure 8 is an alinement diagram used as a rapid method of determining the operating factor of safety.

To illustrate the use of the charts, the following example is given using 1½ in. diam 6 x 25 filler wire construction regular lay rope.

Inspection shows an average length of wear of about 0.500 in. and twenty broken wires in the worst rope lay, distributed as follows:

Strand No.	*Breaks*
1	4
2	6
3	5
4	4
5	0
6	1

Figure 6 — To determine the percentage of the rope area which is intact, draw a line from the percentage of outside wire diameter which remains on scale *C* to the number of broken wires in the worst rope lay on scale *F*. Intersection with Scale *E* gives percentage of the rope area which is intact.



By referring to the diagrams for 6 x 25 filler wire construction regular lay rope shown in Figures 5 and 6, the projections are indicated for calculating the percentage remaining area.

On Figure 5, a line is drawn from the rope diameter on scale A through the average length of wear on scale B to intersect scale C. This intersection indicates that 81 per cent of the outside wire diameter remains intact.

On Figure 6, this figure—81 per cent—is transferred to the per cent-wire-diameter remaining scale C, and a line is drawn from this point to the number of broken wires in the worst rope lay on scale F. The intersection of this line with scale E indicates that 79 per cent of the area of this rope remains intact.

Since the greatest percentage of broken wires in this case occurs in four strands, by referring to Figure 7 it will be found that with 79 per cent of the rope-area intact and the above distribution of broken wires in four strands, the effective percentage of rope-area intact will be 74.4 per cent.

If the effects of deterioration due to internal wear are neglected, the effective percentage of rope-area remaining intact may be taken as the percentage of the rope strength intact.

If the above mentioned rope originally operated with a factor of safety of eight, its factor of safety would be reduced to 5.95 when the rope strength was reduced to 74.4 per cent. This relationship is shown on Figure 8.

When corrosion is not a factor, the remaining strength of the rope will generally not be less than indicated by the charts. The safe plan, however, is to check these figures by an actual ultimate strength test and use the results as a guide. An ultimate strength test has the dual advantage of checking the accuracy of the remaining rope strength and also provides a guide as to what allowance, if any, should be made for internal wear.

In respect to 6 x 37 hoisting ropes at the present time, no charts are available due to the numerous constructions involved.

In such cases, a close estimate of the remaining strength can be arrived at by using the reserve strength of the construction involved, the number of outside wires and the number of broken wires in the worst rope lay. The "reserve strength" of a rope is the strength of the inside wires of each strand. In the 6 x 37 classification, the reserve strength varies from 50 to 60 per cent of the rope strength. The outside wires vary from 84 to 108. These variations are due to the strand constructions involved.

Since our final answer by this method is strictly an approximation, it is satisfactory to use a reserve strength of 50 per cent and the number of outside wires as 100. If, for example, neglecting abrasion, 50 broken wires were present in the worst lay of rope, the strength of the outside wires would be reduced 50 per cent and would contribute 25 per cent to the remaining strength of the rope. Combining the 25 per cent and the 50 per cent reserve strength, the remaining strength of the rope would be approximately 75 per cent. If abrasion were severe, which is usually not the case on ropes of this type, an additional allowance can be made for this condition.

This method of estimating remaining rope strength is strictly an approximation, and should only be used in conjunction with actual ultimate strength tests.

The way a rope stretches—or does not stretch—is sometimes used as an indication of the proper time for removal. This has some basis in fact because, when a rope loses its elasticity, its deterioration is often very rapid. However, when this condition does occur, visible indication is usually present.

In conclusion, the time to remove a rope from service is when the predetermined minimum safety factor has been reached.

The foregoing material, although not covering all situations, does give a general outline of how to determine the strength of a rope at a given time in service, and thus indicates whether it should be continued in service or removed. ▲

Figure 7 — Curves make allowance for the effective area, allowing for distribution of broken wires. Value used for ordinate is that obtained from Figure 6.

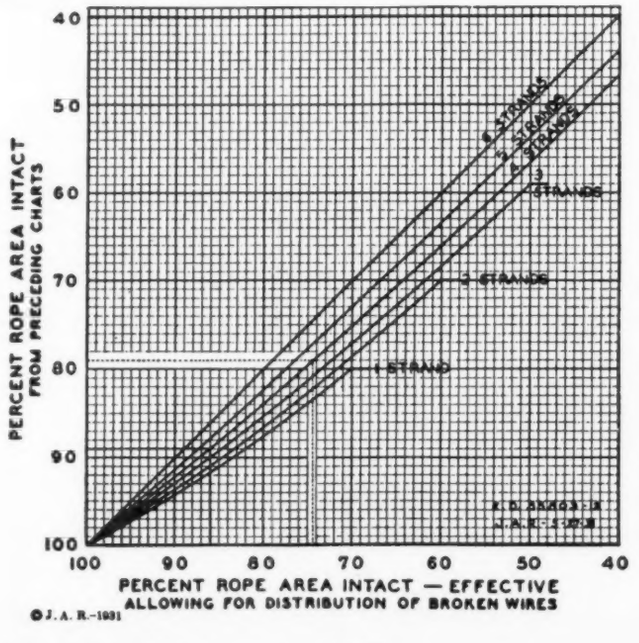
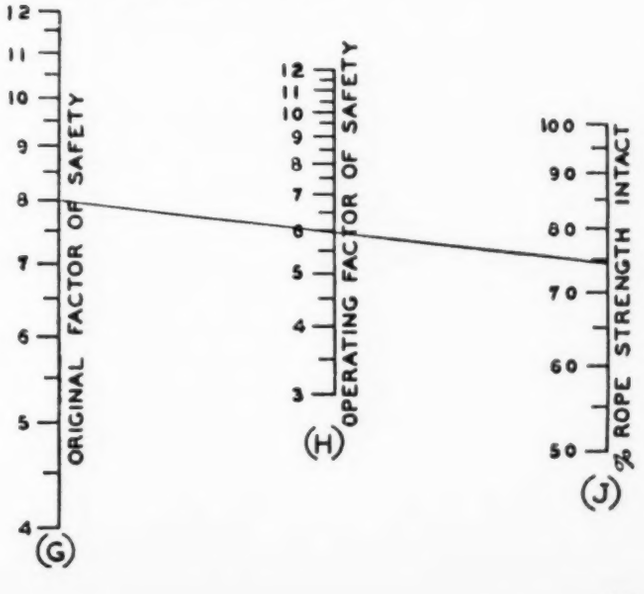


Figure 8 — By connecting the original factor of safety for new rope, scale *G*, with the percentage of rope strength remaining, scale *J*, the operating factor of safety is given at the intersection on scale *H*.



An Operator's Evaluation of the Versatile Gas Turbine

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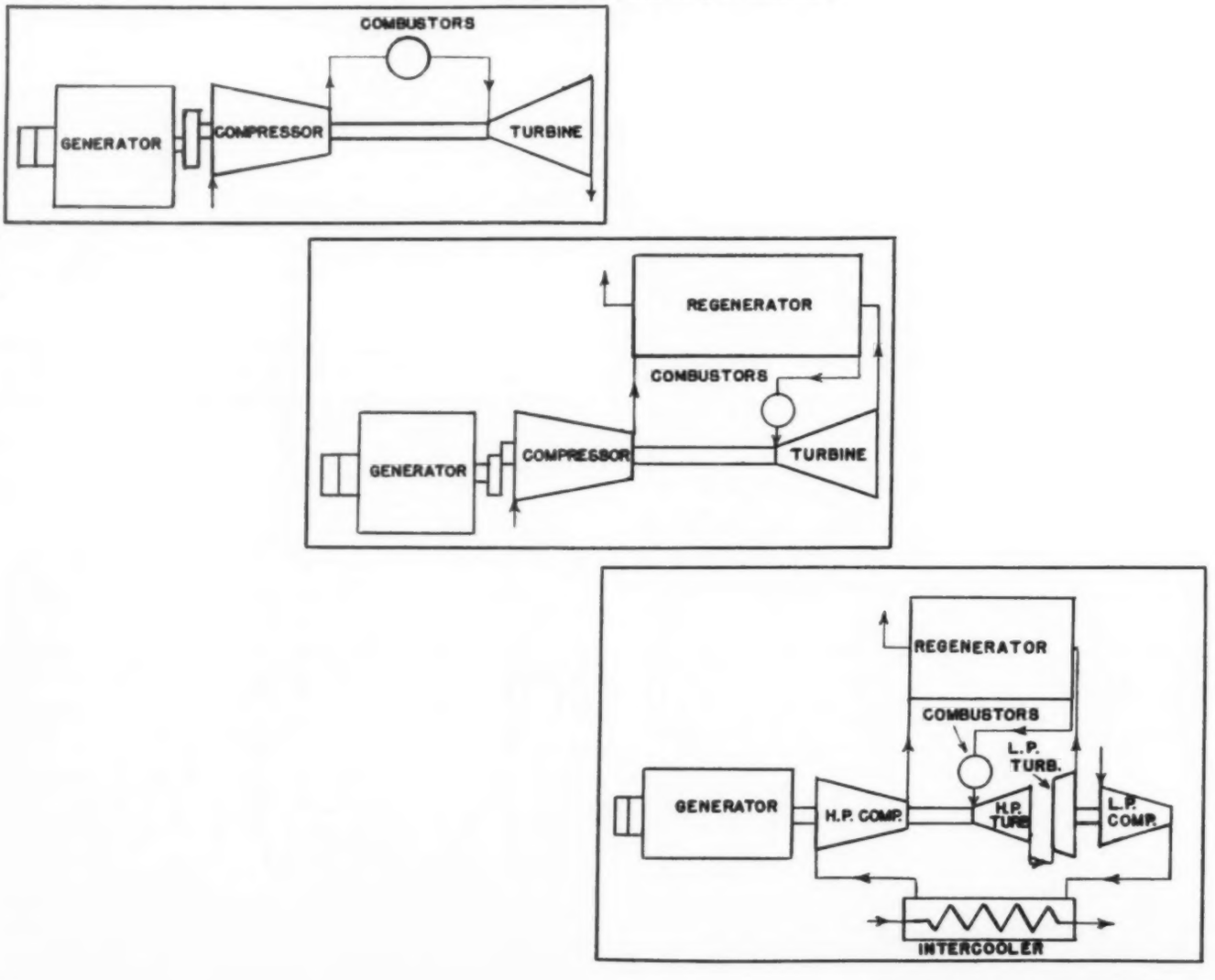
. . . . paper presented at 19th Annual Meeting of the American Power Conference, March 29, 1957 . . . .

SINCE the end of World War II, industry has been faced with expansion to meet added consumer demands. The problem of replacing obsolete power equipment to remain competitive has presented a problem to certain industries. Serious consideration has been given and should continue to be given to the versatile gas turbine to meet expanding or replacement needs of power equipment.

Around the beginning of this century, pioneers in the gas turbine field began to be encouraged in the practicability of the gas turbine, when in 1906 the first centrifugal compressor was built for use with the gas turbine. This presented a solution to the problem of attaining the large volume of compressed air required for com-

Figure 1 — Gas turbine cycles vary in efficiency.



bustion and cooling of the gases going into the turbine and made it possible to use the gas turbine in certain specialized applications to increase cyclic efficiencies such as:

Supercharging the diesel engine by expanding the exhaust gases of the engine through a gas turbine to drive the supercharging compressor.

The development of the pressurized boiler wherein the exhaust gases are expanded through the turbine to drive the compressor furnishing combustion air to supercharge the boiler to 25 to 35 psi.[1]*

The next big step was the development of the highly efficient multi-stage axial flow compressor, which in conjunction with the development of metals that would withstand turbine inlet temperatures up to 1500 F, made possible a prime mover, which is competitive in both reliability and efficiency with all others, and in addition, possesses characteristics and advantages not found in other prime movers.

GAS TURBINE CYCLES

There are three common types of gas turbine cycles in use (Figure 1), ranging from the simple cycle gas turbine which exhausts its hot gases to the atmosphere, through the intermediate type with regeneration, which uses the exhaust gas to return heat to the cycle, to the more complex cycle which adds intercoolers for reducing the work required in supplying air for turbine operation. The cyclic efficiency will range from 12 per cent for the simple cycle through 34 per cent for the complex cycle, which is a real advantage, from the standpoint of obtaining the highest return on capital investment when factors such as fuel costs are taken into consideration.

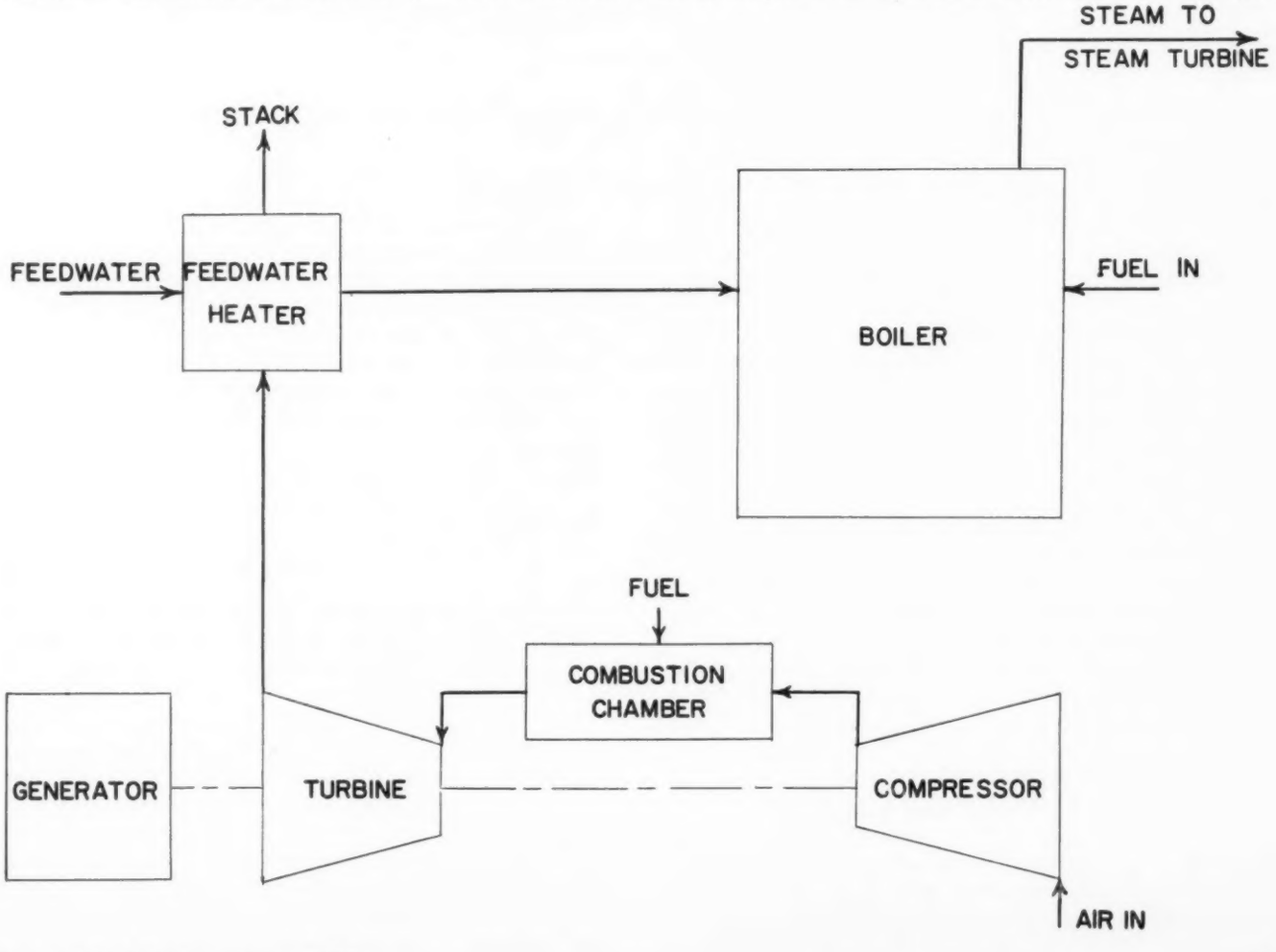
COMBINED CYCLES

The versatility of the gas turbine in fitting into different cycles has stimulated the thinking of operators and engineers and has produced many different steam gas turbine cycles, such as; using exhaust gases for feedwater heating, for producing steam in waste heat recovery boilers, and for combustion air in fuel fired boilers. Additional applications such as, using the heated compressed gases from a process, or using the exhaust gases from a supercharged boiler for operating the gas turbine, are also being developed.

An often discussed steam gas turbine cycle (Figure 2) in the United States is the installation at the Oklahoma Gas & Electric Co.'s Belle Isle Station. The figures and statistics from this installation provide evidence of the gas turbine's abilities as a source of mechanical power. The exhaust gases from the two gas turbine units installed at this station are used to heat the feedwater for the steam plant. After the installation of these units, the over-all station heat rate was improved by 2.5 per cent. If all the heat recovered from the turbine exhaust gases were credited to the gas turbine, the turbine would have an efficiency of

* Numbers in parentheses refer to Bibliography at end of paper.

Figure 2 — Gas turbine exhaust-heat recovery for feedwater heating can give efficiencies up to 60 per cent with this cycle



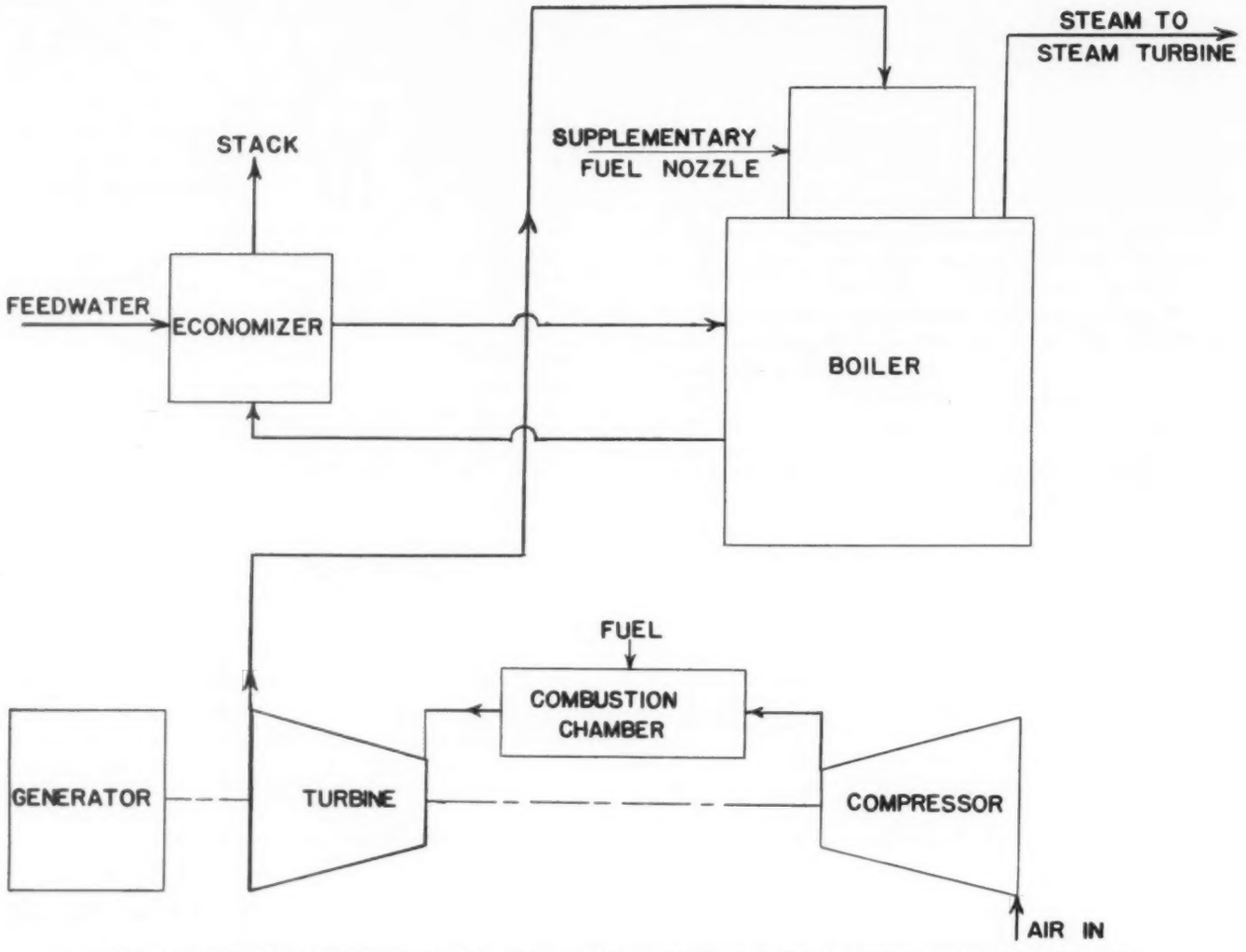


Figure 3 — Combined steam-gas turbine plant with supplementary fired exhaust-heat recovery boilers.

over 60 per cent. The heat reclaimed from the exhaust gases of the gas turbine provided an increase of over 5000 kw from the basic steam station capacity of 51,000 kw. This represents an increase of about 10 per cent in the existing station capacity above the installed rating of the gas turbines which was 9000 kw.

A similar installation at the West Texas Utilities, Rio Pecos Station increased the existing power plant thermal efficiency by 15 per cent and the existing equipment output by 6600 kw with the installation of a 5000 kw gas turbine.

Other specific cycles which have been advanced are as follows:

1. (Figure 3) The exhaust gases may be used to operate a waste heat boiler. To this waste heat boiler, supplementary firing may be added to utilize the 80 to 90 per cent of oxygen in the air left in the gases to increase the steam output of the boiler.

2. A gas turbine arrangement on a high pressure, high temperature boiler may be used where the gas turbine drives the boiler feed pump. In this arrangement, the exhaust gases from the turbine are used as part or all of the combustion air in the boiler.

3. (Figure 4) Designs for supercharged boiler cycles have been advanced which utilize the abilities of the gas turbine as now developed. The boiler would operate above 70-psi gas pressure and exhaust gases above 1350 F to the gas turbine. In conjunction with suitable air and feedwater heaters, and depending upon the complexity of the cycle, over-all plant thermal efficiency over 40 per cent may be attained as well as substantial reduction in space requirements.[2]

4. Utilization of hot process pressurized gases. An interesting installation where hot process gas is used to drive a gas turbine is located in a chemical plant in Mississippi. The air from the axial-flow compressor is used in the production of nitric acid. The exhaust gases from this process, which is under pressure and at a temperature of about 800 F, is passed through a gas turbine, which drives the axial flow compressor and a generator. This arrangement supplies approximately 70 per cent of the power requirement for the process.

PRIME MOVER APPLICATION

The gas turbine has been applied to drive many different types of equipment. It is used extensively by gas companies to drive centrifugal compressors on their gas lines. One gas company which has an installation of over 54 gas turbines with an equivalent of 308,000 hp, has accumulated 400,000 hours of operation and experienced less than 1 per cent of forced outage time.[3] There has always been a need for portable power and the gas turbine has moved into this field as well, to again display its versatility. Portable compressors and generators have been installed on railroad cars and have performed very dependably. The gas

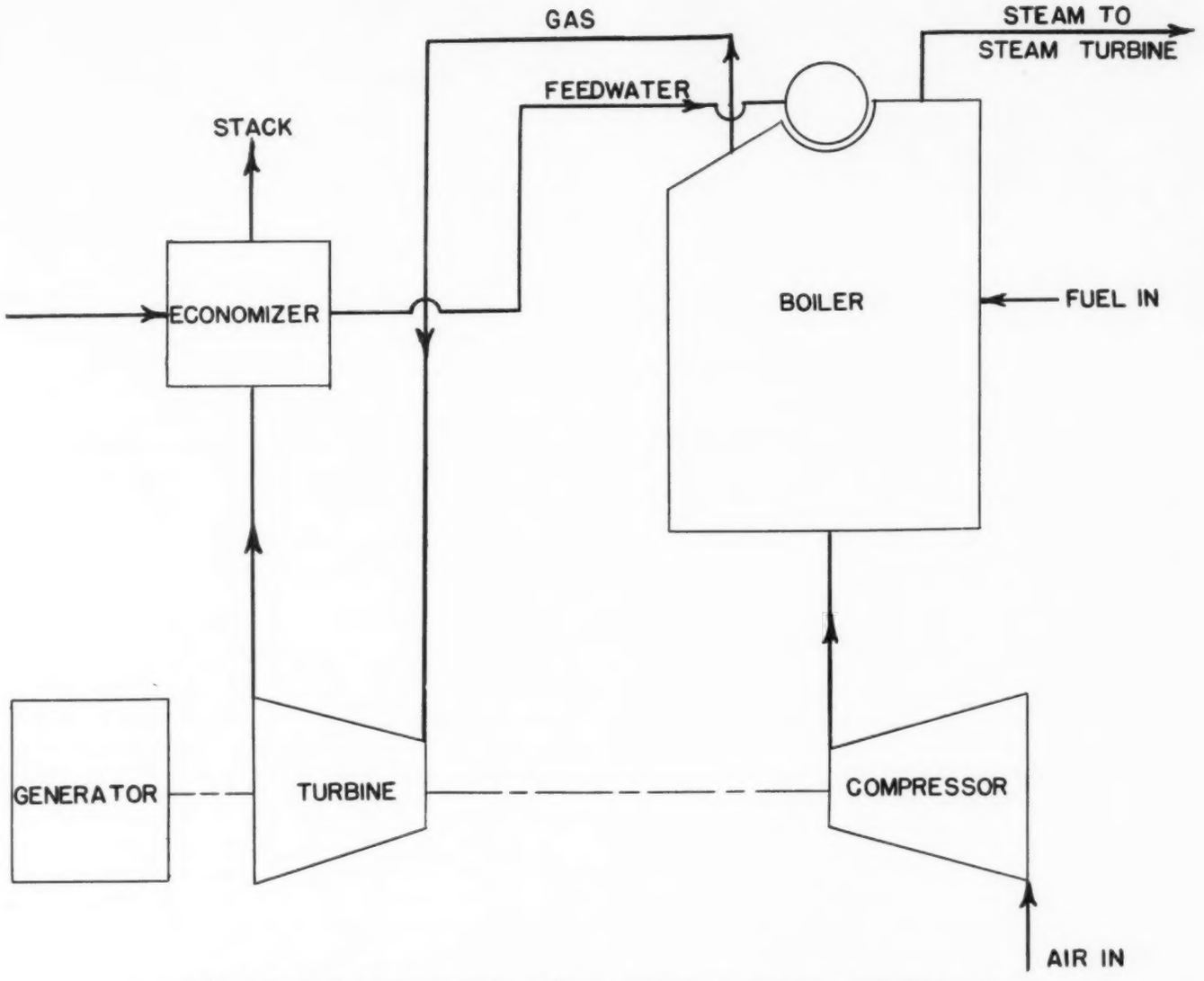


Figure 4 — Gas turbine supercharged boiler cycle has reduced space requirements.

turbine has been used as a source of backup power for hydro stations and for handling peak load conditions for utilities. The ability of this turbine to be ready for service in a matter of minutes makes it very desirable for this type of operation. The simplicity of the gas turbine makes it possible for the station to be remotely controlled and requires a minimum of knowledge of operation by the men used for inspecting remote controlled stations.

The gas turbine's unique characteristic of a material increase in available shaft power at lower outside ambient temperatures is a desirable feature for peak loading equipment. At a reduction in plant efficiency, additional shaft power may also be obtained from the gas turbine by injecting water or steam into the combustion chamber.[4]

FUELS

The gas turbine has displayed a great versatility in the types of fuels which may be used. The most desirable fuel, thus far, has been natural gas. The number one unit at the Oklahoma Gas & Electric Co. has operated over 40,000 hours with very little trouble. At the 30,000-hr. overhaul on this unit, it was reported that the only part replaced on the turbine was the combustion liner caps.

Residual fuel oils have been used as fuel for the gas turbine. It was very quickly found that certain components of the ash from this fuel was corrosive. Research disclosed that vanadium and sodium were the main causes of the trouble. This same corrosive effect was also experienced in the superheater elements of high pressure boilers, which were being developed at this time. Today processes and additives have been developed to minimize the corrosive effect of the sodium and vanadium ash on the blading of gas turbines and on boiler superheater tubes.[5] Distillate oil is of course an acceptable fuel for the gas turbine.

Blast furnace gas is acceptable fuel for the gas turbine. Three installations in European countries using blast furnace gas have operated very satisfactorily. In 1952 tests were conducted in several steel plants of this country with gas turbine manufacturers to determine whether or not the large supplies of blast furnace gas available was suitable for use in the modern gas turbine. These tests proved this blast furnace gas could be used successfully.

The United States Steel Corp., at South Works, is in the process of installing a gas turbine-driven blower.

This gas turbine (Figure 5) will be designed to burn either light fuel oil or blast furnace gas. The light fuel oil will be used as an auxiliary fuel when blast furnace

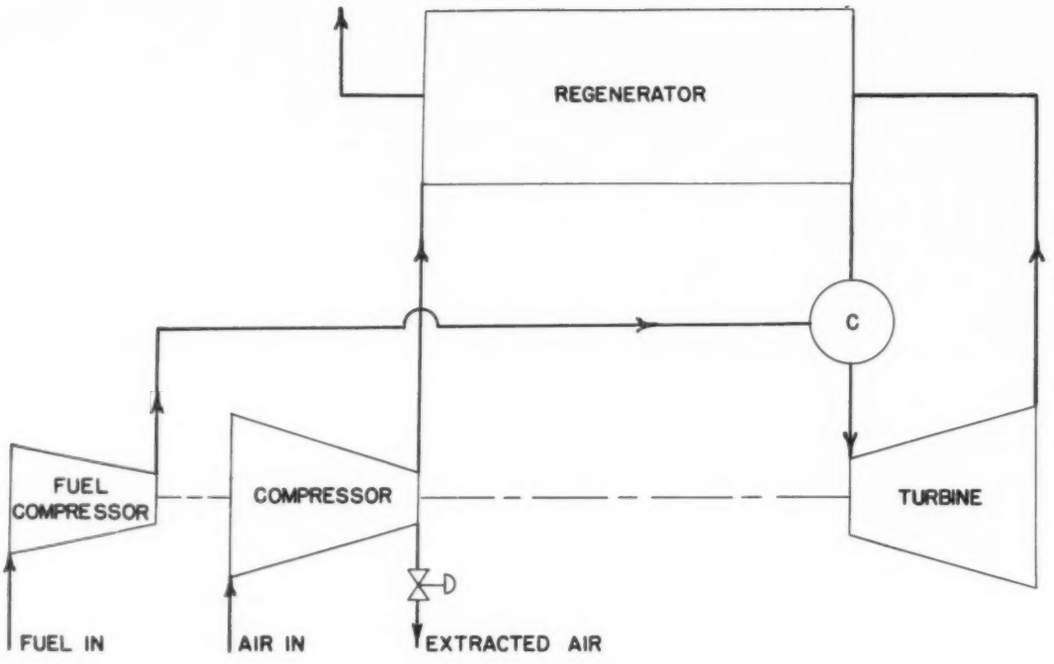


Figure 5 — Air extraction gas turbine can burn light fuel oil or blast furnace gas.

gas is not available. Light fuel oil will also be used in starting the turbine. A small steam driven turbine will be used to bring the gas turbine up to 25 per cent of rated speed at which time light fuel oil will be burned to bring the turbine up to operating speed. The turbine will drive two compressors, one for compressing the blast furnace gas, the other for supplying air to the combustors and for wind for blowing blast furnaces. The turbine will have four stages and operate at an inlet temperature of 1350 F.

The thirteen-stage axial flow compressor will be designed for a capacity at 375,000 cfm, 80 F inlet air, compressed to 35 psig, which will supply the air for combustion and 125,000 cfm for blowing blast furnaces. Air to the combustors and the extracted air will be taken after the last stage of the compressor. With this arrangement, the pressure on the compressor and the turbine will be that required by the blast furnaces. The unit can be operated to maintain a volumetric output, or a pressure on a manifold.

The air extraction performance curve (Figure 6) for this unit displays a great deal of versatility in the range of operation. At design pressure the unit is stable to zero useful output.

The limiting factors exhibited in the performance curve are the lower surge limit which is avoided by bleeding air to the atmosphere to maintain the machine above this range, and the pressure line below which the compressor must not operate if sufficient air for controlling temperature to the turbine is to be maintained. This pressure is controlled by a back pressure valve on the discharge of the compressor which automatically maintains compressor pressure above this line. The control diagram (Figure 7) indicates the method by which these functions will be accomplished.

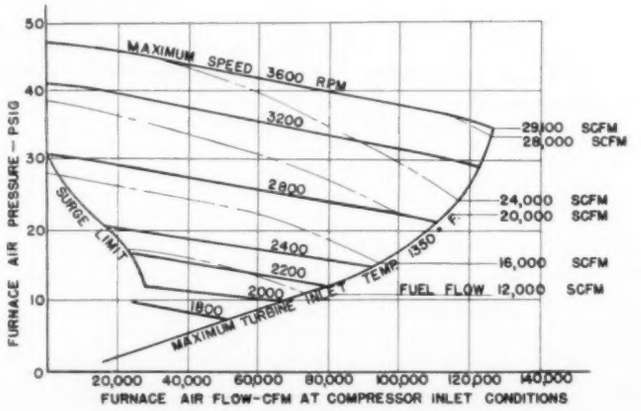
FUTURE

Since the efficiency of the gas turbine is influenced by the inlet temperature to the turbine, developments which permit high inlet temperatures are of considerable interest. The cooling of hollow blading filled with liquid metal which serves to conduct the heat to the root of the blade where it is carried away by water cooling is under investigation. Effusion cooling of stationary blading constructed of porous material or with venting holes are under consideration. Air for cooling would be extracted from the compressor. Intensive research, on protective coatings, and metals capable of withstanding higher temperatures, are well advanced. A steady advance in allowable inlet temperatures to the turbine is a certainty.

A turbine with inlet temperatures of 1250 F with 75 per cent regeneration would have an over-all thermal efficiency of 28 to 29 per cent. The same turbine with inlet temperatures of 2200 F would have an over-all thermal efficiency of 38 to 39 per cent.[6]

The versatile gas turbine is being considered for use in nuclear power systems. Designs for both open and closed cycle nuclear gas turbine plants have been proposed. Availability of cooling water and size of the plant generally dictates which cycle is most desirable. Closed cycle nuclear gas turbine plants appear to be very attractive. One such system considered has a thermal efficiency of about 34 per cent. This plant is composed of two stage compression with intercooler, re-

Figure 6 — This 125,000-cfm blast furnace blower-regenerative cycle gas turbine unit will burn blast furnace gas. Compressor inlet design conditions are 80 F, and 1000 ft altitude or less.



generator, gas turbine and reactor. This is a closed cycle system operating at the reactor with an inlet temperature of about 1300 F and discharging at 125 psig with the gas passing through a cooler where it is recompressed.[7]

SUMMARY

The gas turbine today is not an experimental machine. The hundreds of thousands of hours of experience in operation has proven the gas turbine to be a reliable prime mover. The many hours of satisfactory operation with natural gas, waste heat, fuel oil, blast furnace gas and the considered use as a prime mover for nuclear power plants displays its great versatility in its use of fuels. The ever increasing purchase of gas turbines indicates the competitive ability of the gas turbine cost-wise. Installations of gas turbines with existing steam generating facilities has proven its ability to improve efficiencies of existing equipment as well as increasing the output of this equipment.

The gas turbine has opened up a whole field of ideas. Because of its versatility, it could probably fill some of the needs in your replacement or new construction programs.

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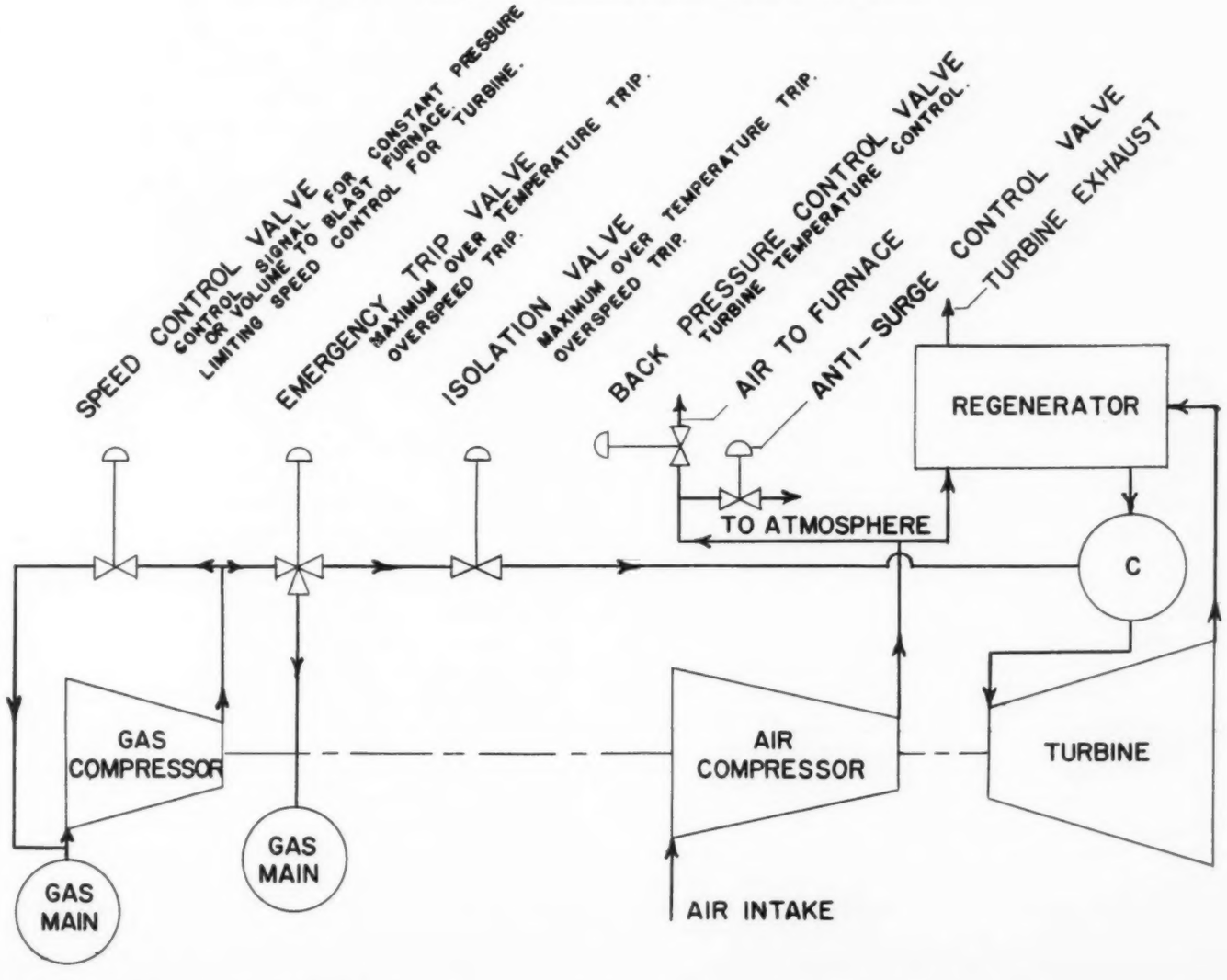
Figure 7 — Functional schematic shows control of gas turbine.



TOMORROW'S ENGINEER

Annual spring meeting stag banquet speech presented at Birmingham, Ala., April 22, 1958

by N. C. Michels
Vice President—Engineering
Tennessee Coal & Iron Div.,
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Birmingham, Ala.

IN the steel business, long-range planning and preparation for future needs has assumed importance at least equivalent to—if not greater—than that of any other industrial undertaking. We are now in the very middle of history's greatest period of scientific and technological advancement; and revolutionary changes in products, as well as production equipment and techniques, are taking place so rapidly that only by making careful plans now to take care of eventualities years ahead can we hope to keep abreast of the times.

What is taking place today in electronics, in nuclear fission and fusion, and in ultrasonic and space flight is dependent to a significant degree upon what has already been accomplished, through forward planning, in the development of new specialized steels and steelmaking methods. As the world moves forward in those and other new fields, the necessity for intensive forward planning becomes even more stringent.

It is common knowledge that the steel industry has been a leader in the development and application of improved production equipment and techniques. Perhaps not so well understood is the fact that the development and training of competent engineering personnel is corollary to—and prerequisite to—advancements in machinery and methods. How well we meet the challenge of the rapidly advancing times depends primarily on how successful we are in obtaining and developing engineers capable of devising and utilizing to the most effective extent new productive equipment and techniques.

For that reason, we think it appropriate to discuss that vital factor in the future of steel—tomorrow's engineer. What is he; how and where do we get him; and how do we prepare him for the job ahead?

At the outset one is aware that the term "tomorrow's engineer" is one of those glittering generalities which the engineer should avoid as a plague. It is not our purpose to discuss the multitudinous attributes, qualifications, attitudes and dimensions of the engineer of the future. We shall also avoid a repetition of training theory which has been so frequently and thoroughly covered in the past. Instead these comments shall be limited to the specifics of recruiting, training and advancement of young engineers with particular emphasis on a program which has been developed through adherence to an informal and unofficial local policy of "providing an opportunity for maximum performance"—a policy which applies to the conduct of our entire engineering responsibility but of necessity is limited here to the early stages of an engineer's business life.

This phrase, "opportunity for maximum performance," could be as vague as the title "Tomorrow's Engineer." However, when looked at realistically, it provides a guide in our recruiting and training activities to:

1. Employ only those engineers for which we expect to have need.

2. Employ only those engineers with excellent potential for advancement.

3. Provide selected engineers with a basic opportunity to develop their latent talents to their fullest extent, such that advancement may occur as rapidly as openings develop and the increase in their skills warrant.

The backbone of our training program is the practice engineer program in which high calibre young engineering graduates are oriented and integrated into our operations. It is this group upon which the corporation and the TCI Division will rely most heavily in the future to fulfill its engineering research, development and management functions. For that reason, a program designed to discover and develop to the fullest the particular talents and potentialities of the individual engineer is of prime importance. In other words, we must not only find the right man for the job; we must also find the right job for the man.

A business magazine last year reported the story of a manufacturer of "do-it-yourself" swimming pool kits who believed in leaving nothing to chance. In the installation brochure which accompanied the kits, Instruction Number One read simply: "First, dig a hole."

The prerequisite for a successful engineer training program is just as obvious, although not entirely so simple: First, find an engineer with the potential for development. Recruiting is considered a vital and integral part of our training schedule.

In the Tennessee Coal & Iron Division, the manager of industrial relations is responsible for the college recruiting and training program. However, each line department is responsible for final selection and training of college recruits assigned to it.

In visiting the engineering colleges of the South for the selection and employment of trainees, we have organized recruiting teams which are composed of representatives of the industrial relations department and capable, responsible officials of the department seeking college graduates who have been trained in recruiting, interview and selection techniques. This system has several advantages. First, it gives the department directly affected a strong voice in the selection of recruits; second, it creates a stronger impression of the division's interest in top quality graduates and thus

is a good "selling" technique; and third, it places on the spot a man who can answer authoritatively any questions the student and prospective employee may have concerning details of the division's operations.

Recruiting at TCI is carried on throughout the year. Preliminary to personal contact, information sheets and brochures are supplied to colleges to be visited, to acquaint interested students with the nature of our operations. At the interviews on college campuses, many of which are pre-arranged group meetings, division representatives furnish the prospective graduates with information about the steel industry in general and TCI in particular. Geographical, recreational, cultural and educational aspects of the plant community are also provided.

Approximately 15 per cent of the candidates interviewed are offered employment. Of the number offered, about half accept. That is well above the industry average. The number of recruits employed is based as precisely as possible upon future needs, as determined by production forecasts, expected personnel retirements, transfers and turnover.

The recruiting program as presently conducted has been in operation since 1952. Since that time, 259 engineers have been recruited from the 27 state and private colleges in the South which graduate engineers. Of these, 141 have been promoted from the training program to assigned jobs within the division. To date, we have an over-all retention rate of 85 per cent.

Training of technical employees at TCI centers around on-the-job training. Classroom work is held to a minimum. Recruits are assigned to selected departments, each of which has its own training program, designed to fit the specific needs of the department and of the individual.

Before reporting to the department to which he is assigned, the trainee undergoes a comprehensive orientation by the industrial relations department. In this preliminary period, he is given an over-all view of division activities, management organizational structure, flow of materials and products, and specific data regarding the department to which he will be assigned.

Job assignments are a combination of office and field work, and are diversified so as to afford maximum opportunity for development of the individual. Work performed includes participation in the preparation of engineering studies on proposed projects; quantity and cost estimates, report writing; layouts of equipment and assistance in designing and developing equipment and methods.

During the two-year training period, the departmental supervisor prepares a written performance appraisal on the trainee every three months. Also every three months, the trainee is personally interviewed by a counsellor in the industrial relations department. These interviews are two-way affairs. Using the appraisal reports, the counsellor discusses with the trainee the progress he is making, points out deficiencies and makes suggestions for improvement. The trainee, in turn, is encouraged to speak frankly with regard to his particular interests and the type of work for which he feels he is best suited. When appropriate, personal problems which may affect his performance are discussed, and help may be offered.

At twelve monthly meetings, various department heads at TCI speak to the trainees on the functions of their various departments. A one-week tour of all operations, including mining, which is conducted sometime during his first six months, also helps the trainee to understand the over-all operation of the division, and to orient himself and his work in the total operational picture.

In the last six months of the training period, trainees are candidates for regular positions. Selections to fill openings are based upon comparative aptitudes and ability demonstrated during training. Many trainees have been selected for regular positions prior to the end of the training period, and have advanced to positions of considerable responsibility.

We have been increasingly aware during this "seller's market" of engineering talent that the engineering graduate has shown a marked reluctance to begin his career in the drafting room. The engineering graduate has either been advised or assumes that drafting and design work is below the standards of a college graduate and unnecessary to the experience background of a capable engineer. We are continuing to insist that as many of our trainees accept drafting and design assignments as possible. However, we recognize the problem and the need for training qualified and experienced drafting personnel.

To meet the need for draftsmen, TCI initiated in 1957 an apprentice draftsmanship program. Positions were offered to a limited number of young men who had completed basic courses in mathematics and mechanical drawing. These were drawn from employees desirous of self-improvement and from among high school graduates in the plant community who could not or did not want to attend college. After careful screening, we selected thirteen high school graduates and eight employees for the course in 1957.

The draftsman apprentice course is a combination of on-the-job training and study. Three days a week are spent on engineering department assignments and the remaining two are devoted to classroom work. A maximum of one year is spent in the study of detail drafting. This is followed by a maximum of nine months study of layout drafting. In this second phase, one day per week is devoted to study of such subjects as pneumatics, hydraulics, materials of construction and machine design. In the other four days, they are assigned duties commensurate with their progress and ability.

This program has been even more effective than we had anticipated as measured by the enthusiasm of the group and their progress in handling detail drafting assignments. We are confident we have discovered an excellent source to fill future needs for well-trained and experienced draftsmen.

In keeping with our policy of providing an opportunity for maximum performance, a college co-operative program was reinstated in 1957 after a lapse of several years. The college co-operative course is offered first to existing employees without a college degree who have demonstrated the initiative and ability to not only complete the course but advance more rapidly by reason of additional educational background. The purpose of the co-operative course is three-fold. First, it provides an additional source of college graduates for training and management development. Instead of waiting until students near graduation and then bidding

against other companies for the best of the crop, we catch some of the most ambitious and potentially most capable as soon as they leave high school. It is our belief that most of those who live up to our expectations will stay with us after graduation.

Second, it provides a source of engineering trainees with the proper educational background and at least limited experience in drafting techniques and engineering practice. As I have already said, today's graduate engineer is reluctant to undertake the drafting work so helpful to his engineering background. The co-operative student, however, willingly accepts assignments in the drafting room during the years he is in college. Furthermore, during that period, he obtains useful practical experience in our operations, to supplement the theory he gets from his textbooks.

Third, it fulfills a community responsibility. Considering the nation's present need for top-drawer engineers, it seems an unfortunate waste of manpower to let financial considerations stand between some talented, ambitious youngsters and a college education in engineering. The co-operative program helps such young men to help themselves to rewarding careers and at the same time contributes to the steel industry and the nation's requirements for engineering talent.

TCI presently has co-operative arrangements with the University of Alabama, Georgia Institute of Technology, and Alabama Polytechnic Institute. In 1957, forty-four young men were enrolled in the program. They are pursuing studies in mechanical, electrical, chemical and mining engineering.

Students are selected for the co-operative program only after thorough testing, perusal of high school records and personal interview, to make sure that the considerable investment we make in their future is wisely expended. Those chosen work during alternate quarters in our engineering; metallury, inspection and research; industrial engineering and mining departments. We counsel regularly with these employees, and maintain a close check on their on-the-job and academic progress. They are required to perform satisfactorily in both areas.

For those men already performing well in engineering management, United States Steel has set up an advanced training program aimed at making more effective use of their talents and encouraging them to assume increased administrative responsibilities. Engineers with outstanding potential are chosen from the corporation's various works, divisions and subsidiaries, and are assembled at Pittsburgh for a training period of forty-one weeks' duration. Prerequisites for enrollment are at least five years of experience in engineering assignments and demonstrated ability, judgment and initiative which indicate a capability for further advancement.

The program is divided into two phases. The first has to do with technical and management training, while the second is devoted to personal development. In the first phase, the trainee has an opportunity to become acquainted with operations problems and activities at the corporation level. He makes a thorough study of four phases of steelmaking as conducted at United States Steel's central operations; namely, coke and coal chemicals, iron, steel and rolled products. He also visits other corporation facilities, to gain a broader understanding of the facilities and processes of the corporation as a whole. Through discussions with engineering executives and actual work experience in corporation engineering offices, he becomes familiar with the various engineering functions. Knowledge thus gained helps him to relate the work of his division, works or subsidiary to that of the corporation and thus makes for better co-ordination.

The second phase is concerned with the man, himself, and helps him to develop those traits of character which will better qualify him for greater managerial responsibilities. He gains awareness of his strengths and deficiencies, gains self-confidence, emotional maturity and the ability to get along with others. He also learns methods used to make sound decisions, develops his judgment and builds a stock of knowledge to help him in the performance of management functions.

In keeping with our policy of providing an opportunity for maximum performance, the training and development program as outlined is designed for qualified personnel from the high school graduate to the advanced and experienced engineer. As a matter of fact, it is entirely possible through this program that a high school student first employed as a messenger by TCI could progress through the apprentice draftsman's course, the college co-operative course, the practice engineer program, and the advanced engineering management development program to become a fully trained and qualified engineer with advancement dependent only upon his initiative, ability and time required to obtain necessary experience.

We thoroughly believe that this type of total program will result in a level of engineering background and ability qualified to accommodate the many problems facing "tomorrow's engineer."

We do, however, recognize that the training program to date is incomplete inasmuch as it does not adequately provide an opportunity for many of our experienced and capable engineers to obtain additional skills relating to new techniques, processes and equipment.

The coming of automation is perhaps the best example of the need for special training to meet special conditions. Automation is increasing the requirements for trained and skilled engineers just as it is necessitating an improvement in the skills of many industrial employees. More than anything that has come about in recent years, it can raise the level of the entire employee force. But we can take advantage of its benefits only as fast as we can provide engineers and technicians with the knowledge and skills to make it work.

We are seriously considering the employment of additional educational opportunities such as refresher courses in certain engineering principles as currently available from undergraduate classes in institutions of higher learning, and the initiation of courses in advanced technical training as related to the steel industry only. These latter courses would be conducted by qualified corporation technical personnel, utilizing available texts for the several processes of our industry.

Thus are we at United States Steel and TCI working, through training, to meet the challenge of the times. We believe that our training program is among the best answers yet devised to the problems of technological advancement, economic growth and social responsibility. ▲

Ventilation of Large Industrial Buildings Under Heat Load

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. . . . paper presented at Annual Meeting, Industrial Hygiene Foundation, Pittsburgh, Pa., October 30, 1957 . . . .

SOME of the largest industrial buildings in America can be found in the steel industry. These buildings are long narrow structures with high roof bays, sometimes extending more than one hundred feet above the floor. A typical modern hot strip mill building may be 1900 ft long, 120 ft wide and 75 ft high. Most of these buildings are under heat loads which are considerably in excess of normal.

Consider the air required to adequately ventilate a building with 228,000 sq ft of floor area and 17,100,000 cu ft of air volume. Then multiply this system many times to accommodate the requirements of a large integrated steel company. The final figure for ventilation in cfm is immense. This paper will outline the history of one steel company's efforts to satisfy its ventilation needs so that its employees might receive the best possible ventilation at the least possible economic stress.

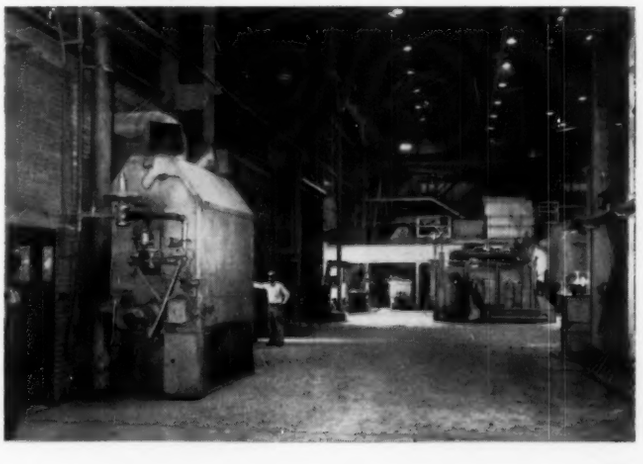
When considering industrial ventilation, it is economically wise to consider both heating and ventilating in one single unit. This was not the case in the beginning in steel plant ventilation. In the beginning "gravity ventilation" was the only means provided for environmental cooling. In this installation, roofs were equipped with canopy ventilators. The sides of the buildings were removed during warm weather and the air was permitted to sweep in through the sides, up and out through the canopy ventilators. The heat source, such as a furnace or hot rolling mill, provided draft for the system. This system produced cool areas along the sides of the buildings, but virtually no relief in the center of the building where most of the work was being performed. During cold weather the building was closed up as tightly as possible in order to utilize as much heat as possible from the heat source. The canopy ventilator, heat source and leaks in the outside walls provided cold drafts throughout the building. These drafts were overcome with gas, coal or coke fired salamanders for local heating. One can imagine the number of potential industrial hygiene hazards in this type system. Surprisingly enough, some industrial buildings are still being ventilated and heated in this manner, and this situation is not limited to the steel industry.

"Steel Facts," a publication of the American Iron and Steel Institute, in its June, 1957, issue printed the following: "At the dawn of the 'Age of Steel' in the United States, about 100 years ago, the estimated total production of steel was approximately equal to one hour's output by the modern industry." The total yearly output of steel in the United States has risen from approximately one-half million tons in 1856 to 115,000,000 tons in 1956. This tremendous and rapid growth has brought with it many problems of concern to the industrial hygiene engineer.

The first recognition of these problems by industry, in the form of active corrective measures, took place approximately thirty years ago. It was at this time that the steel industry realized the direct relationship between good industrial health and production. It was this realization, and the corrective measures instituted, that caused the initial concern over good ventilation practices.

In order to correct adverse industrial health conditions, it became necessary to exhaust processes guilty of emitting environmental air contaminants. This exhaust ventilation placed virtually all industrial buildings under negative pressure. Most operators have had the experience of attempting to open a door leading into a plant building and having to exert considerable force

Figure 1 — This type of gas-fired unit heater consumes valuable floor space.



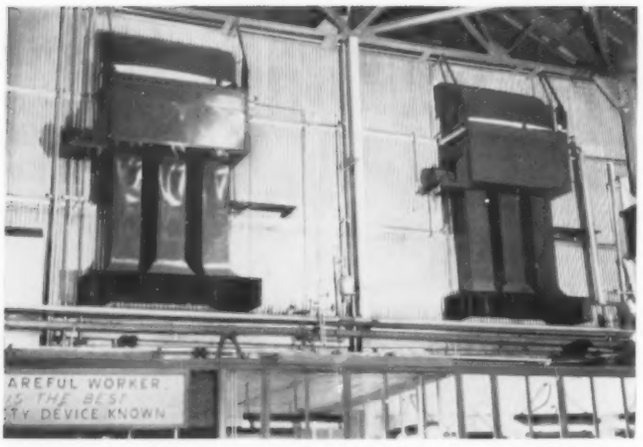


Figure 2 — Unit heater is wall mounted to conserve floor space.

to counteract the negative pressure inside the building. This negative pressure increased the number and velocity of already existing drafts around the perimeter of the building. It soon became evident that old methods of industrial heating were not applicable in this new era of exhaust ventilation.

Although it would appear that heating of industrial buildings is far afield from the title of this paper, "Ventilation of Large Industrial Buildings Under Heat Load," this concern over heating was actually the first big step forward in the evolution of industrial cooling. The maintenance problems and limitations involved in the use of unit heaters and ventilators, eventually brought about the installation of area air conditioning systems presently in use at the Weirton Steel Co. These problems and limitations are relatively well known, but will be discussed at this time to point out the advantages of area air conditioning.

Figure 1 shows a gas fired unit heater capable of producing 15,000 cfm of heated air. This unit consumes valuable floor space, uses 100 per cent precirculated room air and is a constant winter maintenance problem due to the coke-oven, gas-fired jets. They provide poor localized air distribution and are of no value as air cooling or make up air units. For even limited industrial heating, one large building may require several of these units, each unit presenting a separate maintenance problem for the electrical, mechanical and fuel departments.

Figure 2 shows a unit heater ventilator which goes one step further towards the ultimate goal of good industrial air conditioning practice. This unit is of 12,000-cfm capacity, designed to deliver 100 per cent outside air during both the heating and ventilating cycles. The unit is wall mounted to conserve on floor space and to provide better air distribution. The use of 100 per cent outside air helps to offset the negative pressure present in modern industrial buildings and also produces some cooling during hot weather. It does, however, provide poor air distribution due to the necessity of locating the unit on an outside wall; and the multiplicity of units necessary for heating or ventilating a large building provides many separate maintenance problems for the mechanical and electrical departments. Maintenance is reduced on this unit by the use of steam coils for heating in place of coke oven gas shown in the first slide. These units are satisfactory for small areas with available outside walls or low roofs.

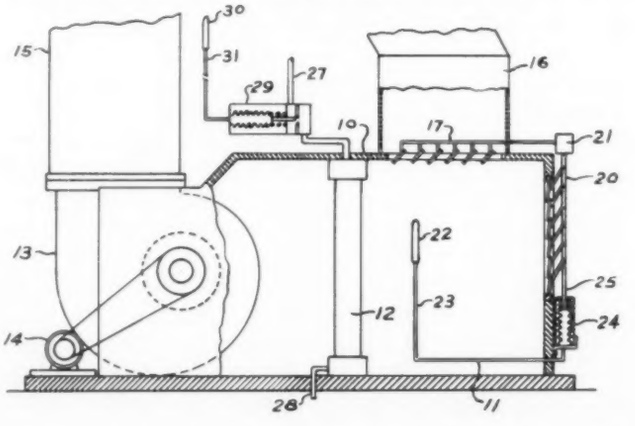
In 1943, during the second world war, the Weirton Steel Co. constructed a large building to house facilities for the manufacture of shells for the government. It was in this building that the company installed its first controlled damper, area air conditioning system. This system, patented by Mr. W. W. Kompart, former combustion engineer, Weirton Steel Co., has served as a prototype for all future installations in new construction of large buildings. For purposes of this paper, a large building will include any area greater than 50,000 sq ft. This system, installed thirteen years ago, is still in operation in this building, which is now used as a company warehouse.

Since 1943, the Weirton Steel Co. has installed ten additional systems of this design. These consist of four units at 120,000 cfm, three units at 174,000 cfm and three units at 212,000 cfm, plus the original unit in the shell plant, for a total of almost 2,000,000 cfm of conditioned air. According to figures received from one of our ventilation contractors, these units can be installed, complete with heating coils, fan, ductwork and automatic thermostat controls, for less than 50 cents per cu ft of air capacity.

In designing this system, our engineering department had several objectives in mind. These were: (1) design a system that would eliminate the multiple maintenance problems encountered in the use of unit heater ventilators; (2) supply the maximum amount of conditioned fresh air (not less than two cfm per sq ft of floor area) without unduly increasing the cost of heating the air; (3) provide an efficient method of thermostatic control to maintain constant uniform room temperatures and eliminate manual control of the system; and (4) provide efficient air distribution at an elevation above the floor capable of producing maximum value per cu ft of conditioned air.

A drawing of the system designed to accommodate these objectives may be seen in Figure 3. This system consists of a casing 10 containing a plenum 11 and a heater or radiator 12. An air circulating motor driven fan 13–14 is provided at the outlet end of the casing for circulating air through the system and discharging conditioned air through the outlet duct 15 to the area to be conditioned. The casing is provided with an inlet duct 16 which communicates with a source of outside air and which an adjustable normally open damper 17 is mounted for controlling the amount of outside air drawn into the plenum. A recirculated air duct 19 ex-

Figure 3 — This air conditioning control system reduces maintenance and has good operational efficiency.



tends through the wall of the casing and communicates with the space being conditioned. An adjustable normally closed damper 20 controls the amount of recirculated air drawn into the plenum. The dampers are interconnected through a suitable linkage or other means 21 so that the outside air damper is held in its normally open position when the recirculated air damper is closed as shown in the drawing. These dampers are so designed to admit a uniform total amount of air to the plenum, regardless of the relative amounts of fresh and recirculated air.

A thermostat 22 is mounted in the plenum so that it can respond to the temperature of the air as it enters the conditioning system. This thermostat is electrically connected to a drive mechanism, which is in turn connected to the recirculating dampers. When the outside air temperature is above a predetermined temperature, such as 32 F, the dampers remain in their normally open and closed position as shown. As the outside air temperature drops below 32 F, the thermostat actuates the drive unit and progressively closes the outside air damper and opens the recirculating air damper so as to admit sufficient recirculated air to maintain a mixed air temperature of about 32 F in the plenum. If the temperature in the plenum rises above 32 F, the thermostatic control causes this action to be reversed. Thus, the air flow control means is responsive to the outside air temperature and is automatically operable to admit both fresh air and recirculated air when the outside air temperature is below this predetermined temperature in order to maintain a temperature in the plenum equal to or greater than 32 F.

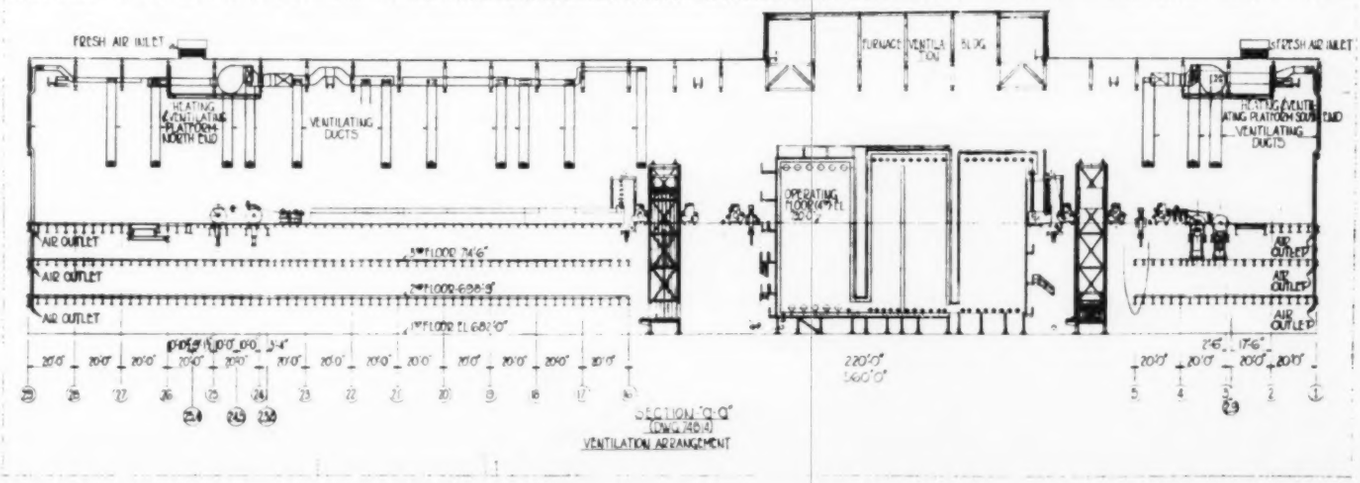
The air conditioning radiator 12 is connected through a pipeline 27 to a steam source, and is connected through pipe 28 to condensate traps. An electric driven valve is provided in the steam line for controlling the amount of heat supplied to the heating coils. A thermostat 30 is mounted in a suitable location in the area to be heated and is responsive to the temperature in this area. This thermostat is operatively connected to the valve 29 through an electric driven motor, so as to automatically open or close the valve the proper amount to maintain a substantially constant room temperature. For most installations, room temperature during cold weather is maintained at 74 F. If, for some reason, room temperature rises above 74 F, the valve restricts the flow of steam to the radiators; and if the room temperature drops below 74 F, the valve progressively opens to increase the flow of steam. The radiator is so designed that when the air in the plenum has a temperature equal to 32 F, which is the temperature at which the recirculating damper begins to open, the radiator operates at maximum capacity to maintain a discharge air temperature of 120 F at the fan outlet.

So far we have achieved three of the four objectives previously listed. We have designed one single air conditioning system to replace the numerous small unit systems. We now have maintenance on one fan, one fan motor, and one set of steam coils, whereas a comparable system designed on a unit basis would have required from 10 to 20 such individual maintenance problems. It is no more of a problem to maintain one 200,000 cfm control system than it is to maintain one capable of producing only 15,000 cfm. By making provision for recirculation of small amounts of room air, we have been able to eliminate peak loads on the heating system during extremes in cold weather. This has made possible the delivery of large quantities of outside air during hot weather for area cooling, while maintaining a sensible heating cost during colder periods.

Recirculation of air in industrial ventilation always brings up questions of contamination of the air being discharged from the system into the working environment. For this reason we prepared data which shows maximum and minimum outdoor daily temperatures for one year at our plant in Weirton. From this data it was observed that on only nine days during the year 1955 were we required to recirculate air for a period of 24 hours. These days are those when the maximum temperature for the day dropped below 32 F. In order to recirculate 50 per cent in-plant air, the outside air temperature would have to go below −10 F. Our lowest recorded temperature for the year was −4 F on February third and fourth. On these two days, for very short periods of time, we were recirculating approximately 46 per cent of the total amount of air handled by these systems.

However, recognizing the potential problems of contamination present in recirculation of in-plant air, our engineering department has been very careful to locate these units in the areas of least contamination, even at

Figure 4 — Schematic of ventilation system for continuous annealing line building.



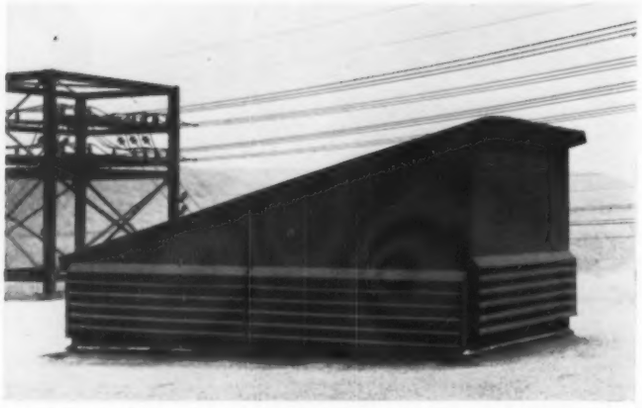


Figure 5 — The outside air is brought in through two small penthouses.

the expense of providing much longer headers than would have been required with a more desirable location. Considerable effort has also been made to locate these systems in sections of the building exposed to the least amount of process heat to provide more efficient cooling during hot weather.

Thermostatic control of the system is very important during the three seasons of fall, winter and spring. During the winter months, the control located in the plenum, which regulates the position of the outside and recirculated air dampers, is subjected to many variations in air temperature. This control must operate effectively to maintain a proper balance between recirculated air and outside air during cold weather. An improper balance in either direction would cause obvious defects in the supply system. In the spring and fall, wide variations between maximum and minimum outside temperatures places a heavy burden on the steam control thermostat, located in the area under ventilation. These thermostatic controls, with thermohm temperature controls are connected with signalling controllers. These in turn regulate motorized controls on steam and dampers. As may be seen in a later figure, a valve is located in the steam line to modulate the heat input to the heating coils. These controls require very little maintenance and have operated satisfactorily over a period of several years.

The fourth objective concerning distribution is the most important single factor in the success or failure of an area air conditioning system. Many ventilation dollars have been literally "blown away" by the failure to provide proper distribution.

Distribution of the conditioned air in an area air conditioning system is also the most expensive part of the system. Controls, heating coils and fan costs are almost incidental to ductwork costs. This fact makes it very easy for the design engineer, always of necessity conscious of cost, to take short cuts in distribution and supply which seriously impair the efficiency of the system.

Figure 6 — Air escapes through high bay gravity ventilator.

Air distribution in steel plant buildings is complicated by the almost universal use of overhead cranes and crane runways. This means that all vertical drops must come down on either the outside walls, or between the crane rails of two adjacent runways. Instead of one row of vertical drops down in the center of the building, it is necessary to make one row of drops on each side of the building. This duplication of ductwork further increases the cost of air distribution. In Figure 4 may be seen a drawing of a ventilation system recently installed in a large building housing a high speed continuous annealing line. This continuous annealing furnace has a maximum heat requirement of 80,000,000 Btu per hr and approximately 1000 kw. The furnace is 109 ft long, 21 ft wide, and 77 ft high. It is the only heat source of any significance located in this building. The building itself is 560 ft long, 121 ft wide, and 120 ft high.

Heating and ventilation in this building requires the use of two 174,000 cfm area air conditioning systems. The two area air conditioning units are located at opposite ends of the building. In the center of the building, directly above the annealing furnace, is a large high bay gravity exhaust ventilator.

The interior design of this building is rather unusual. In the northeast and southwest corners of the building are two three-story enclosures. The center and west side of the building are one-story sections from ground floor to ceiling. From a ventilation standpoint, this means that we had to provide ventilation for three separate buildings.

Outside make-up air is brought in through two small penthouses (Figure 5) located on the low bay roof sections. Furnace heat and products of combustion are allowed to escape through the high bay gravity ventilator (Figure 6) located directly above the annealing furnace. Some idea of the size of this ventilator may be obtained by comparison with the employee shown in this picture. By bringing the air in around the perimeter of both ends of the building and exhausting directly above the heat source, we are in effect sweeping conditioned make-up air across all floor areas and exhausting the spent air, plus furnace heat and products of combustion, out through the gravity ventilator. The basic idea in this design is not new and is almost identical to that used years ago, when the sides were removed from the buildings with gravity ventilators providing exhaust through the roofs. The important difference, and one of the main reasons for the installation of area air conditioning systems, is good air distribution. As stated earlier, good air distribution at the proper elevation above floor level, is the key to satisfactory industrial ventilation. Within certain sensible limits, it is not so important, in degrees Fahrenheit, what temperature is maintained in industrial buildings; but it is of extreme importance that this temperature be uniform and relatively constant throughout the working area, and that air movement be present at all

times. To obtain employee satisfaction, you must eliminate hot and cold spots in the working environment. The human body can easily recognize temperature differentials of as little as plus or minus two degrees Fahrenheit.

Distribution n this building requires the use of 70 separate discharge outlets. Each outlet contains six vertical vanes preset for uniform air distribution. Each outlet is equipped with a manually operated damper control system. The outlets are located between 10 and 12 ft above floor level and are directed towards the floor at an angle of approximately 45 degrees. This elevation and angle of discharge was chosen to obtain maximum coverage per cu ft of discharged air. Figure 7 shows a typical row of discharge outlets along the northwest wall of the continuous annealing building. The overhead crane shown has freedom of travel for the entire length of the building. The location of the vertical drops between the crane rail and the siding are typical of all steel plant distribution systems. A similar row of drops and discharge outlets are located on the opposite side of the building.

The velocities maintained in these systems are as follows: intake—1000 fpm (maximum), across the heating coils—1000 fpm, fan outlet velocity—2500 fpm, main runs—2200 fpm, drops to floor—1400 fpm, discharge outlets—950 fpm. The discharge outlets deliver 5925 cfm. These outlets are so arranged to supply not less than two cu ft per minute of conditioned air, per sq ft of floor area. This minimum figure of two cfm per sq ft has been proven by actual experience on previously installed systems, to provide satisfactory cooling for the majority of our operations. There are, of course, isolated locations throughout our plants, where intense localized heat loads require spot cooling, in addition to area air conditioning.

The following figures were taken following installation of area air-conditioning systems at our tin mill and sheet mill operations.

Figure 8 shows the steam lines, controls, and condensate traps on a 174,000-cfm system located at our tin mill cutting lines. In the center may be seen the electric driven valve for controlling the amount of steam supplied to the heating coils. The governor valve previously mentioned is located directly above the motorized valve.

Figure 9 shows the steam coils and thermostat for this system. This thermostat controls the position of the outside and recirculating air dampers. Recirculated air enters the system when the temperature at this thermostat drops below 32 F.

Figure 10 shows the position of the air dampers when the intake air temperature is above 32 F. The outside air damper is located at the top and is at its full open position. The recirculating air damper shown at the bottom is completely closed to admit 100 per cent outside air. The mechanical motorized linkage between these two dampers may be seen at the bottom left side of this picture.

Figure 11 shows the outside air intake for this system.

Figure 12 is a picture of a header recently installed above the sheet mill galvanize lines. This header was run down through the building trusses, thus avoiding the expense of installing two smaller ducts to accommodate structural details. Expansion joints are pro-

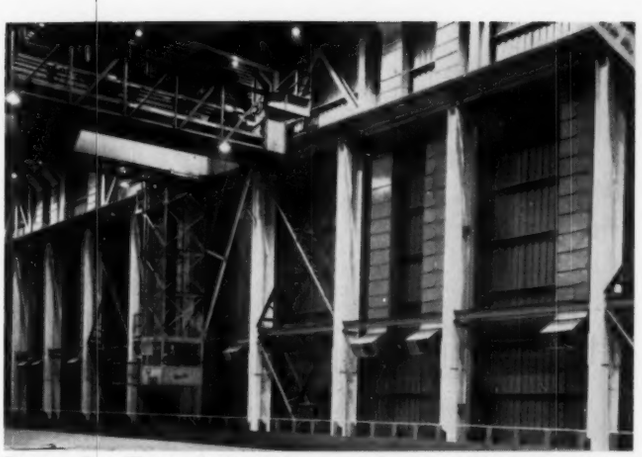


Figure 7 — Typical discharge outlets on wall of annealing building.

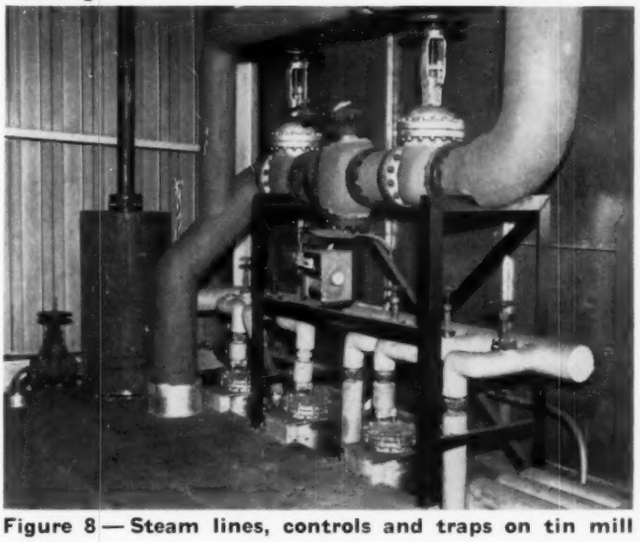


Figure 8 — Steam lines, controls and traps on tin mill system.

Figure 9 — A thermostat controls position of outside and recirculating air dampers.

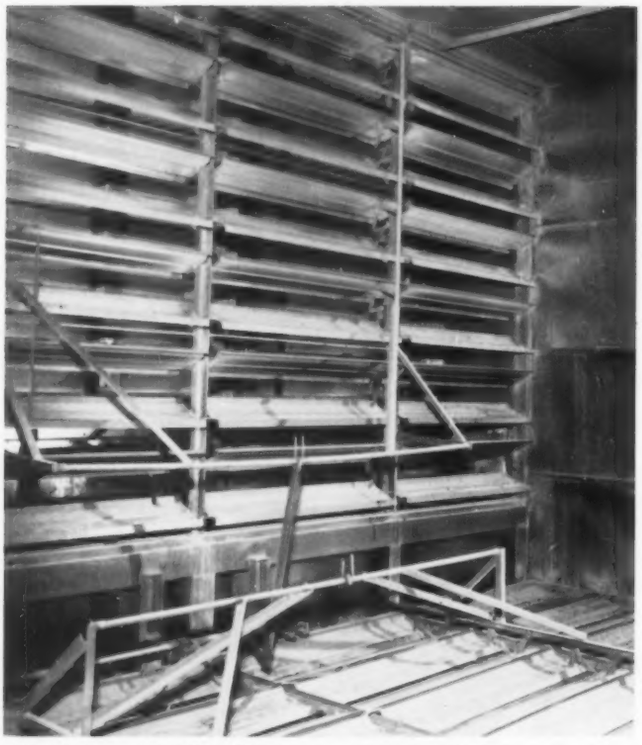


Figure 10 — Outside dampers are shown full open and recirculating dampers are shown closed.

vided in the ductwork in between each set of trusses to eliminate stress on the ductwork from expansion and contraction of the structural members. Crane runways are located on opposite sides of the columns requiring vertical drops of the type shown on the left hand side.

SUMMARY

In summary, by installing these area air conditioning systems, we feel that we have satisfied our ventilation and heating requirements in these buildings for many years to come. This has been accomplished at a cost which, although initially high, will prove to be very low when extended over the life span of the system. By making the installation of a heating and ventilating system an integrated part of new construction, we have been able to make a planned, well organized attack on the problems of heating and ventilation. This has eliminated the hit-skip methods of control using unit heaters and ventilators which are constantly one step behind employee complaints and one step ahead of available maintenance.

The industrial hygiene advantages realized from the installation of area air conditioning are almost too numerous to mention. Problems of an industrial hygiene nature, which one would normally predict in a new installation from past experience, just do not materialize when good ventilation is provided. The buildings are provided with a constant supply of fresh outside air at all times, which, at a rate of two cu ft per min per sq ft of floor area, allows sufficient dilution of contaminants to eliminate a large number of health problems normally present in the absence of good ventilation.

Those of you who evaluate ventilation systems on the basis of air changes per hour, will find that air supplied at the 10-ft level at a rate of 2 cfm per sq ft of floor area is equivalent to 12 air changes per hr. There is no advantage to be gained from supplying this air at a higher elevation. These systems are installed purely for the benefit of the employee. All of our employees, with the exception of crane operators, work at floor level; and the temperature of the air at the 20, 40, or 60-ft level is of no consequence in considering employee comfort. Where necessary, overhead crane cabs can be supplied with individual air conditioning units.

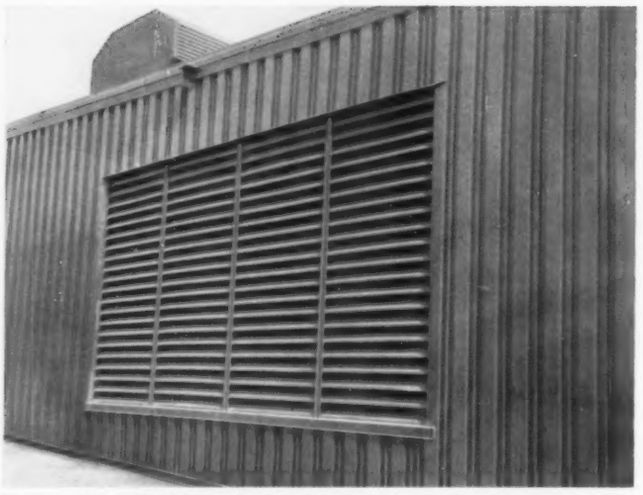


Figure 11 — Outside air intake for tin mill system.

Figure 12 — Headers were run through building trusses.

The problem of adequate ventilation for large industrial buildings has been with us for quite some time and is certainly here to stay. Nothing will be gained by employing stop gap measures of a temporary nature in hopes that the problem will quietly disappear and be forgotten. Commercial establishments, such as department stores, theaters and hotels, have all recognized the necessity for comfort cooling. Office building contractors are placing as much emphasis on comfort cooling as they are on comfort heating in order to provide a constant, year-round temperature. Even our homes are sprouting window air conditioners in much the same fashion as they did television antennas eight to ten years ago. The general public is growing more and more to expect these environmental conditions at their place of employment.

In recognizing this problem, our engineering department has made the installation of the system described in this paper an integral part of all new construction at the Weirton Steel Co. This article has described a suggested and proven means of comfort cooling and heating, with the desire that it may be of some value in solving problems of industrial ventilation. ▲

Card Programming Control of Rolling Mills—I

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. . . . paper presented at meeting of ASME, Pittsburgh Section, February 11, 1958. . . .

THE perforated card, the conventional punched business machine card has, for many years, been the star performer for the accountant in mechanized accounting and the engineer is now adding to its uses the automatic control of materials processing equipment. This type of information handling medium is moving rapidly into increasing importance in the automatic control of industrial processes. For many industrial processes, the card punching format used is greatly different from that used in the accounting application; however, the punched card method and its mechanization hardware are adaptable to the new automatic control schemes and the various binary code modifications allow a great deal of processing information to be conveyed by a single card.

With this trend to card programming of industrial machines and processes personnel in plant engineering, maintenance, and operations, as well as the equipment manufacturers' engineers, must become thoroughly familiar with these new concepts in automatic controls. These groups must become familiar with punch card techniques, in order to maintain and operate these initial installations, and in order to soundly plan future equipment additions designed to produce products at the lowest attainable cost.

This paper will indicate the pioneering and progress in numerical control applications to industrial operations: and more specifically to rolling mills. In addition, the pros and cons of card programmed mills from the steel manufacturer's standpoint will be compared. Numerical controls have appeared first in sheet metal stamping for the turret punch operation. These punches have been operating for years on the basis of drawings supplied by the engineering department. These drawings for the punch operator's use have shown X-Y axes as position settings for each hole to be punched along with the punch number to be used. Once numerical position regulators had been developed, it was a short step to install position regulators on the machine and provide the information that was formerly on the drawings now on either punched cards or tape. This has resulted in increased output from these machines.

The next area where numerical control appeared was in the area of machine tools—milling machines, lathes, shapers and others. Here, there are two types of automatic control—numerical from punched card, or tape and record playback. In using record playback, the machine tool operator performs the machining job and his exact operations are recorded on magnetic tape. From then on, this tape will control the machine which produces identical pieces with the man only removing and inserting material into the machine, changing dull tools and returning the tool to the exact starting point.

In any punch card control, a programmer must visualize the operation of the machine tool and prepare detailed numerical instructions to the machine in the form of punched business machine cards.

In the steel industry, we see this numerical control coming into being on universal reversing roughers for hot strip mills. Two are currently in operation in the Pittsburgh district. One sets screw position, roll speed and number of passes by the use of punched cards. Another unit has recently gone into service on another reversing rougher in the Pittsburgh district; however, in this case, in addition to the functions mentioned previously, it is arranged to actually start-stop-reverse the main drives and tables, position edger, and complete the piece once the roller starts the first pass. This type control is also planned for application to other mills including blooming mills, structural mills, and slabbing mills.

At Geneva Works, U. S. Steel Corp. has a universal rougher equipped with automatic numerical control on the screws and edger opening; however, in this case the information is set in by hand on plug strips as each order enters the production schedule. Here, one man operates the mill whereas in much older installations, with no automatic controls, it requires two men. In the Geneva installation, just mentioned, it is but a short step to add the equipment to utilize information in punched card form. Thus the real novelty in card programming is not in screwdown and edger positioning, but in the automatic reversal of edger, mill, tables and manipulating the piece in process.

In considering something as new as automatic rolling mills and numerically controlled primary mills, it is not realistic to consider only the advantages without a comparison of the problems that may result from such usage. In this paper, we shall indicate, first, the problems and, finally, the advantages.

In the initial concept of card programming, the basic assumption is made that the primary rolling operation may be completely programmed from the office, before the fact, and punched cards prepared in advance, along with the rolling schedule. Currently the roller operates the mill on the basis that he sees all operations and can

alter the operation as changing conditions occur. Thus an important requisite for success of card programming is the provision of a person or persons in the office who can visualize the operation before the fact and convert screw movements, motor speed, acceleration rate, side guard position and manipulator position to decimal dimensions and time sequence for punching into business machine cards. This person must also have all the knowledge of a roller to determine reductions per pass, mill speeds, effects of steel grades, and temperatures but, in addition, must apply this knowledge without the benefit of meter indications of load and other visual aids the roller on location sees and uses. A possible problem then is the fact that we must provide, in the office, a man of greater skills and vision than the present rollers to prepare and build up a library of punch cards, check rolling schedules that the card picked from the library is exactly right for each and every operation on the mill and prepare new cards whenever there is a deviation from standard practice. Also, he must continually revise his cards based on complaints from supervision, quality control and the roller on the mill.

The rolling of steel is not as routine an application of numerical control as the turret punch press, the lathe or the milling machine, because in those cases if the tool is in the exact spot the exact product dimensions will be achieved. It is not so in rolling hot steel, because of roll wear and the tremendous pressures used causing mill and roll deflections. The variables affecting these are ingot temperature, steel chemistry and surface conditions. The disadvantage noted here is that the making of cards is not a mathematical routine as in the case of the milling machine but must be tempered with *estimates* of the magnitude of the variables mentioned.

There is a supervision problem in the area of responsibility for mill wrecks, cobbles and quality. At present, we place the responsibility for failures on the roller. Under the card-programmed setup, we may often hear the alibi, "the machine failed."

In furnishing a punched card programming on a rolling mill, we must assume that the altering of a rolling plan, to fit differences between individual pieces, is a minor part of the roller's job and a rigid rolling plan will improve and not affect quality. In the card controlled mill, temperatures, steel composition and surface must be closely controlled if we are to take maximum advantage of this mode of operation. The importance of uniformity in the incoming product must be emphasized. Any preprogramming system will fail in the face of nonuniform entering material. Because there will always be occasional pieces that vary from good practice, we must provide manual controls and personnel in order that the mill may return to present day manual methods for varying conditions that may appear. It may be difficult for the operator, in an emergency, to take over a single function, in case of material or equipment deviation; he, in all probability, must assume all rolling functions for that particular piece. The roller's rate of pay may be in its present enviable position because the job may be more than routine, requiring on-the-spot skill and fast decisions in the face of each ingot being a little different than the previous one; consequently, a challenge in the application of punched cards to mill operation is to achieve better uniformity, yet maintain the interest, skill and ingenuity of the crews and mold the card system and the crews to meet any changing conditions of the incoming product.

Now, may we indicate where the advantages lie in this type operation. It is in improved production rate, improved quality, and reduced crew fatigue. The area of productivity improvement may be analyzed in this manner. Assuming 400 two-slab ingots per turn and the normal number of screw movements, reversals and manipulations, there are probably between 15,000 and 20,000 individual operations in eight hours. Assuming the new control can save an average of 0.1 sec on each of 18,000 operations, it totals 30 min added rolling time which should produce 250 tons additional per shift or, at 1000 turns per year, 250,000 tons additional capacity. We are talking very subtle differences in speed of operation when we consider 0.1 sec per operation as a savings. Perhaps it can save more time than this assumption.

In the quality area the advantages lie in the uniformity of practice *from day to day, between slabs on an individual order,* and *between the various crews.* Presently each roller, among three crews on a mill, has his personal concept of rolling practice to produce adequate quality along with sufficient quantity to provide a good incentive pay. This concept of rolling practice varies between crews because of various levels of training, experience and skill. With the card programming, it is an opportunity to achieve uniform rolling practice between all crews, because all crews will use like cards for like orders. Here it is reasoned that there is *one* best practice to use in converting a particular ingot to a bloom or slab, and this best practice repeatedly used will achieve good uniform quality at excellent production rates. In this case, it is assumed that if we reduce each ingot for a particular order in an identical manner, the quality will be more uniform. This may be true if ample soaking pit capacity is available and close ingot temperature control is maintained.

Card programming can be a material factor in reducing crew fatigue when one considers the number of individual operations that must be done each turn (15,000 to 20,000). Averaging these figures, it is at a rate of one every 1.5 sec; add to this the watchfulness required, and we can readily see the fatigue factor affecting both quality and production. It is my opinion a man can out-produce an automatic control for a short run of 45 to 60 min because of intelligence and flexibility, but physically the man cannot maintain this pace for 8 hrs nor for 5 days a week. The machine and control are tireless and can maintain a uniform pace. Card programming should minimize fatigue and improve the desirability of the job.

There are, no doubt, other benefits we do not now visualize. Rarely is automatic equipment installed that we do not find additional uses that were not considered in the early stages. These automatic mills will give opportunity to compare product and output with conventional mills and perhaps cause changes in practices on present mills.

We have indicated both the advantages and the problems associated with numerical control on rolling mills. The potential gain in quality and productivity for the expense of a few controls, rather than a complete mill, remains the all-important item and every effort should be expended to solve the engineering, operating and administrative problems involved. ▲

Card Programming Control of Rolling Mills—II

by R. G. Beadle and W. E. Miller, Metal Rolling & Processing Engineering
Industrial Engineering Section, General Electric Co., Schenectady, N. Y.

. . . . *paper presented at meeting of ASME, Pittsburgh Section, February 11, 1958* . . . .

THERE is great interest today in improving the productivity of primary and continuous rolling mills. The approach generally considered is through increased level of electrification to achieve great automation and more automatic production. Programming systems using punched cards of tapes are being purchased and installed for many processes.

REVERSING HOT MILLS

All the rolled products of the steel plant pass through the reversing blooming and slabbing mill. As finishing facilities have been increased or speeded up, there has been an ever-increasing demand to raise the output of the reversing mill. The output of this mill, as of any mill, is clearly related to the time that metal is actually in the rolls. If there is no metal in the mill, there is no output. This is an important consideration because on most reversing mills, the slab will be in the mill generally from 25 to 50 per cent of the time. The remaining time is spent in manipulating, conveying the slab to and from the mill, reversing the mill, and operating the screw-downs. If production requires ten passes per minute, some of these functions may be performed 5000 times in one turn. Therefore, it is reasonable to expect that an automatic control which does not fatigue can improve the productivity of such a mill.

The first step towards more automatic control is punched card preset screw-down control. While preset screw-down control has been quite common for many years, the important change is the use of a punched card for defining the program. The first installation of such a control using a punched card was placed in operation October 4, 1956, on the reversing roughing mill at the Brackenridge Plant of the Allegheny Ludlum Steel Corp. (Figure 1).

A more advanced form of automatic control is now being installed on another reversing roughing mill. Here there will be three modes of operation: manual, semi-automatic and fully automatic. During manual operation, all functions will be manual as they have been on previous mills. During semi-automatic operation, only mill speed and screws will be programmed. During fully automatic operation, all functions normally accomplished by the operator will be done automatically. That is, as the slab approaches the mill, the operator will initiate the automatic cycling and the mill will perform the necessary number of reversing passes including all auxiliary operations. During fully automatic operation, the functions which will be programmed automatically are as follows:

Mill Functions

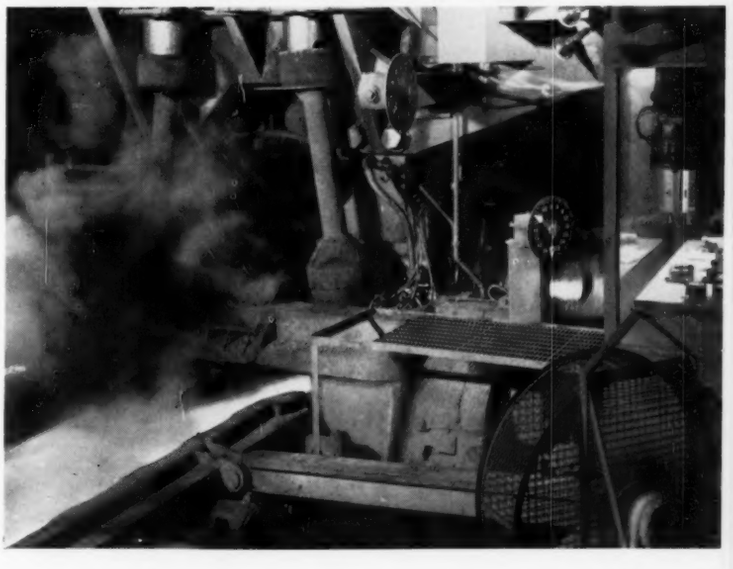
1. Main drive direction and speed (6 speed points).
2. Main drive screw-down (0.025 in. increments up to 8.575 in.).
3. Draft compensation or edger speed (in 5 per cent increments from 15 to 60 per cent below main mill speed).
4. Edger screw opening (⅛ in. increments from 20 to 85 in.).

Auxiliary Functions

1. Scale breaker screw-downs (¼-in. increments from 4½ to 7½ in.).
2. Approach tables (On or Off).
3. Delivery sprays (On or Off).

A portion of a sample of the punched card which will be used is shown in Figure 2. Basically, the program-

Figure 1 — Reversing roughing mill, Allegheny Ludlum Steel Corp., Brackenridge, Pa., has utilized punched card preset screw-down control since October 4, 1956.



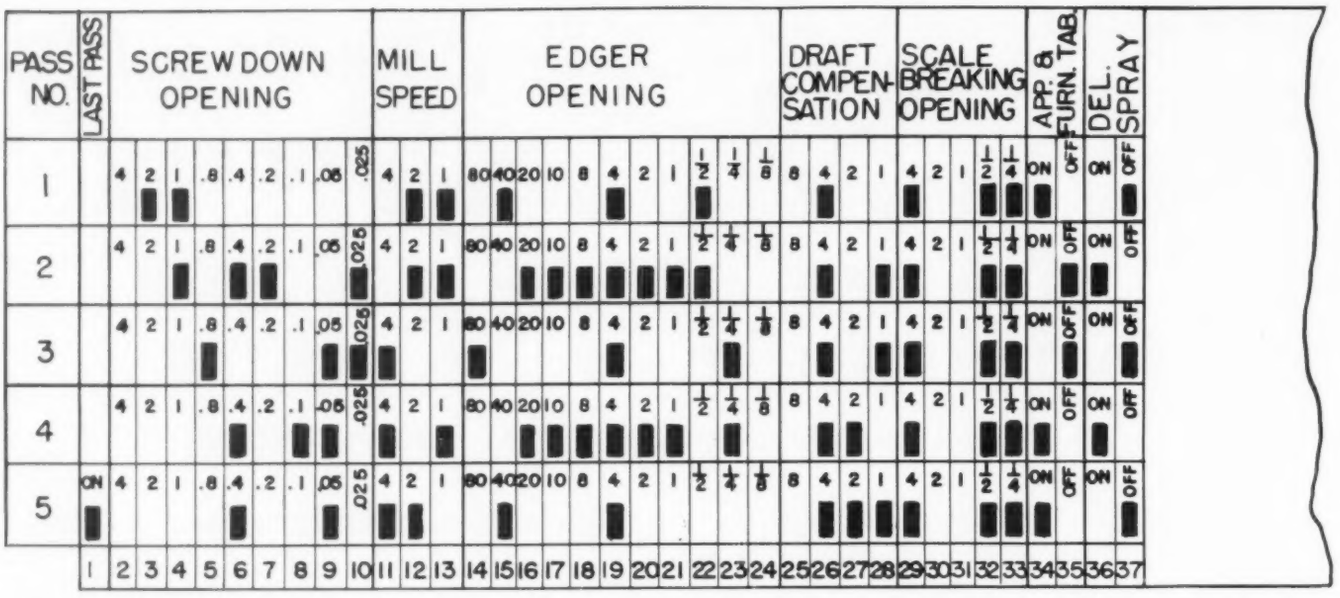


Figure 2 — Portion of standard business machine card used shows binary decimal code system utilized for programming.

ming is built around a 1, 2, 4, 8 code in so far as applicable. A comparison of the sample card with the above list of functions will illustrate how the code is employed. For simple on-off functions such as sprays or the approach table, a simple 1, 2 code is used as shown on the card. For positioning the three screw-downs, a selsyn system is utilized. For the simple selection of speed points or on-off functions, a system of relays is used to select the proper point.

The control system which is required to accomplish these events can briefly be described by referring to Figure 3. All program information is stored in the punched card which is inserted in the card reader. The reading of the card is sequenced by the various signals shown entering the system from the left. The outputs of the reader are then channeled to the proper portions of the mill control system.

If the equipment is operating in the automatic mode, the sequencing which controls the timing of the mill functions will stem from several strategically located hot metal detectors as shown in Figure 4. A hot metal detector is an optical device employing a photo transistor which detects the radiation from the hot metal. These detectors co-ordinate the operation in the following manner. As the slab approaches the mill, the first detector closes the scalebreaker side guides to center the slab on the table. The second detector operates the scalebreaker sprays and the third detector operates the mill sprays. These three functions are employed on the first pass only. Now the slab passes through the edger and mill. As the trailing end of the slab passes under the entry slowdown detector (No. 4), the mill slows to a low speed. This function is timed such that the slab reaches this speed just as it emerges from the mill. The final stop and reverse of the slab is initiated by the first detector on the delivery side (No. 6). For the remainder of the passes, the four detectors near the mill (No. 4, 5, 6 and 7) control slowdown and reversal until the schedule is complete. Similarly, the card reading is advanced for each pass to program other mill functions.

Now let us consider how the various programmed functions are accomplished. The three screw-down signals feed into three position controls of the form shown in Figure 5. The first box, the code converter, converts from the numbering system used on the card to the decimal system required for the position control. The output of the code converter selects the proper position reference which is then compared with the selsyn output. The error is amplified, and then drives the motor to the proper position.

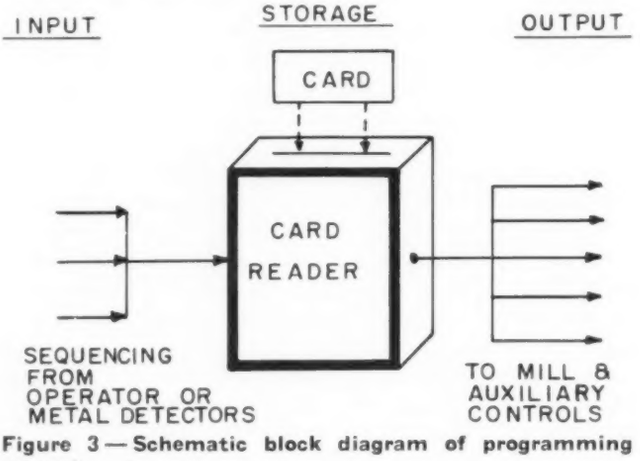
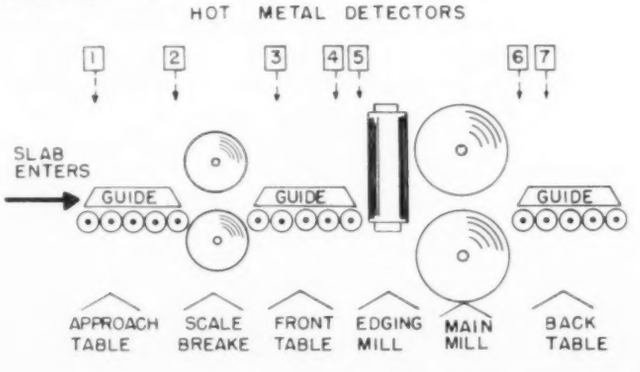


Figure 3 — Schematic block diagram of programming control.

Figure 4 — Schematic diagram of automatic reversing roughing mill.



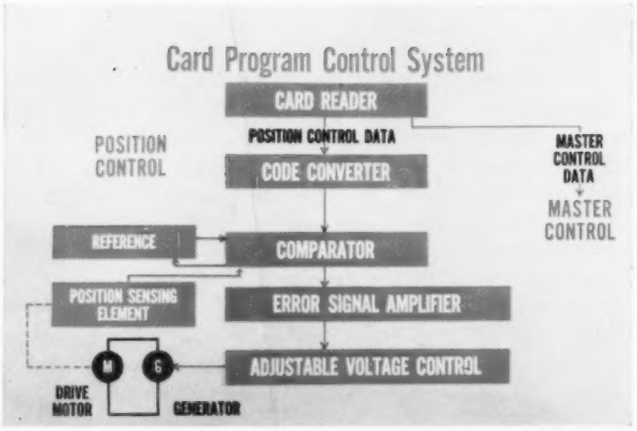


Figure 5 — Block diagram of card program control system.

The main mill speed is set to one of six preset speeds. The adjustment of mill speed from the programming control is accomplished simply by inserting the proper switching in the mill regulator. In other respects, the mill regulator is similar to that in conventional mills.

A tachometer driven by the main mill provides a reference to the edging mill to set the basic or rough speed match between the two mills. However, this speed match is made more accurate through compensation as a function of the draft in the main mill. Draft compensation, which is read from the punched card, is accomplished in the edging control by means of proper switching circuits.

The other functions, sprays and approach tables, are simply on-off functions, and require only simple switching from the programming control.

RESPONSIBILITY OF ELECTRICAL EQUIPMENT MANUFACTURER

Probably the most important factor to consider when evaluating a highly automated system, such as a card programmed system, is dependability. The questions to be answered are: (1) How many hours per year will the equipment produce at its maximum output and (2) when the equipment requires emergency repair, how simple is the problem of trouble shooting and repairing? While dependability has always been important in the steel industry, the increasing capital investment and greater production of a given machine makes it even more so. An hour of downtime becomes more expensive every day. Consequently, any discussion of card programming systems requires a considerable discussion on dependability. This is the one single most important area that will make or break an automated system.

The concept of dependability implies first, that operation be as trouble free as possible. Second, if trouble occurs, it should be easy to locate and repair. To illustrate these points, consider the steps taken in the design of a card programming system of the type just described.

In order to make the equipment trouble free, the following concepts were established and adhered to:

1. Static card reader.
2. Static switching.
3. Transistor amplifier (no tubes).
4. Selsyn position detector.

(1) Considering available card readers, it is generally accepted that a static reader, which reads a stationary card, is more dependable than one which reads "on the fly." The rapid reading of the second type occasionally results in reading errors. In a rolling mill programming system, a reading error could conceivably cause severe damage to the mill. (2) The use of static switching to replace relays is a trend undoubtedly familiar to everyone. The advantages are obvious since the static switch has an extremely long life. (3) Also for this same reason, transistor amplifiers are used in place of vacuum tubes. (4) At the present time, the selsyn for position feedback represents one of the most dependable devices available today. It has been used extensively for years in thousands of applications.

Now, the second consideration: ease of repair. Here these concepts were established and followed:

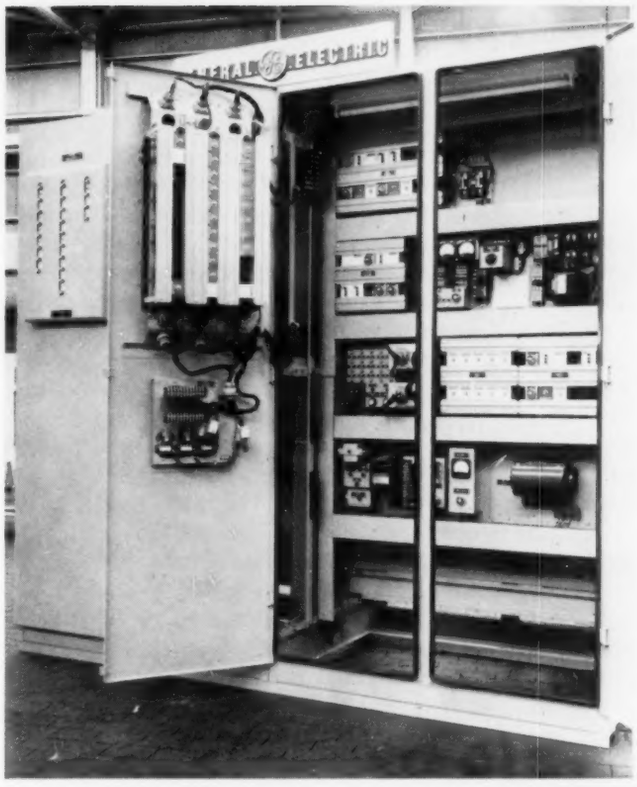


Figure 6 — Front view static type program control panel for horizontal and vertical rolls of universal slabbing mill.

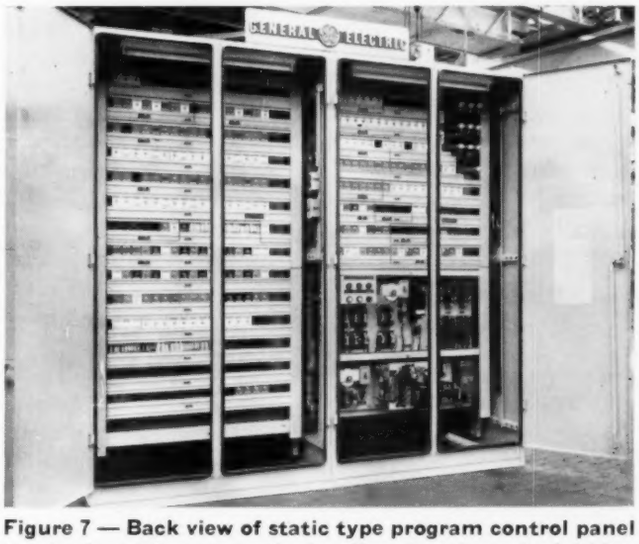


Figure 7 — Back view of static type program control panel for horizontal and vertical rolls of universal slabbing mill.

1. Checking features.
2. Unitized construction.
3. Use of basic modules.
4. Training of user's personnel.

(1) The first of these is probably the most important since it permits one to search through the equipment and isolate any difficulty. In the equipment provided, several checking features are included. Upon initiation, the equipment will automatically check every contact and wire in the card reader, the code converter, and associated circuits, and indicate by lights the location of any faults. To check the circuitry of the amplifiers, test voltages are applied automatically which allow the continuity and amplification to be checked throughout. (2) Unitized construction refers to the segregation of components into functional packages. This makes it possible to replace a complete functional unit if so desired. The unit can then be repaired without holding up mill operation. (3) The word "module" refers to the individual components which form the functional unit. A module may be a single static switch, a single stage of amplification, or a single discriminator. Thus, when these components are used in several locations in the equipment, the same module is employed, thereby simplifying the spare parts problem. Also, since the modules are plug-in, a functional unit can be repaired simply by replacing the faulty module.

(4) Finally, the importance of training the user's maintenance personnel cannot be overemphasized. The trouble shooting features described above simplify maintenance, but special training is extremely helpful. The manufacturer of the equipment must, therefore, supply instruction manuals and even training courses, if complex automating equipment is to be successful. One point, which is often overlooked, is that these training courses must be given to the individuals who will actually be working on the equipment. Training supervisors is fine, but also train the man on the job.

WHAT DOES THE FUTURE HOLD

Let us take a look at the future in this area of programming control. Normally the future is viewed, as though a dream, from the standpoint of the weird and wonderful things to come. However, let us take a more mundane approach—where are improvements required, or more knowledge required, to *permit* progress in the future? This burden of obtaining improvements and knowledge falls on all concerned: the electrical manufacturers, the mechanical machine builders and the users.

ELECTRICAL EQUIPMENT

The primary improvement required in the electrical equipment is, as discussed above, dependability and ease of maintenance. For dependability, the electrical industry has for some years been turning to more and more static devices and solid state devices. This should continue to be the trend. In such devices, the characteristics either age not at all, or at a very slow rate. Ten years with absolutely no attention is a good target. However, no matter how hard we try there will still be some maintenance. The locating of trouble should be as nearly automatic as possible, consistent with cost, of course. It would then be a simple job for the maintenance man to replace the faulty component.

In the area of static electrical devices, one serious need has been an industrial card reader. Such a card reader would be very rugged, have no electrical contacts to cause failure, and be easy to service. As of this date, there appears to be no such reader available for standard accounting cards.

Equally important as static devices is the area of connections which will permit plug-in and quickly removable components. This same subject is also of great concern in military circles where the problem has been studied continuously for years. Indications are that a very high per cent of failures in complex electrical equipment is due to faulty connections. Since improved connectors are constantly being developed, let us hope the future holds the "perfect" solution.

MECHANICAL EQUIPMENT

It is apparent that dependability is equally important in mechanical equipment, but there is another area that is also important if progressive automation is to result. The present form of mechanical equipment has evolved over the years as the most satisfactory for manual operation. However, automatic control cannot match an operator's ability to see and his ability to think. Therefore, the mechanical equipment may have to be changed somewhat to compensate. As an example, there may be a better way to manipulate an ingot than is presently used. At the present time, a very complex sequence of events is required on a blooming or slabbing mill to turn the steel 90 degrees. Furthermore, the present method is effective primarily because an operator can see the procedure as it happens. If the ingot fails to turn, or if it turns too far, the operator realizes it immediately and compensates. It is conceivable that there may be a more positive way of manipulating which will permit easier automation. This is only one of several examples where mechanical improvements might be made. Here is an area which will require close co-operation with the mechanical manufacturer, but it will result in over-all equipment which is simpler and more dependable in the long run. We are confident that progress in this area will take place as the needs become apparent.

CONTRIBUTIONS OF THE STEELMAKER

One objection is frequently raised by steelmakers against card programming for certain types of mills. In some cases, steel makers have said that they have so many products and sizes, that the number of cards required is much too great. They have stated, "the time required for an operator to choose the proper schedule, and select the proper card from the file is much too long." This indicates that some sort of information storage means, other than punched cards, is required. There are many such devices available today, such as magnetic drums, magnetic cores, etc. If the additional benefits justify the cost, these memory devices can be incorporated into the programming systems.

However, there is another aspect which must be considered. Even if many programs can be stored, there is no assurance that the utilization of the mill equipment will be optimized. There is no assurance that the

mill motor will be worked to its limit, or that the mill itself will be worked to its limit, or, for that matter, that the material being rolled is worked to its limit. This then leads us to the conclusion that a mill might be controlled by some sort of computer that would actually have the necessary rolling theory stored in it. That is, such a system should be able to decide how a particular product should be rolled, if it knows the condition of the mill equipment, the type of material being rolled, the entering and exit sizes, and all other data required which has a bearing on the process. However, in spite of the tremendous background of information which rolling mill operator's have, it is not a simple matter to define their practices in a consistent theory of rolling on which a computer could work. Here, we believe, is the area in which the steelmaker can contribute most. If he could explain rolling theory in such a way that it would cover all possible circumstances, it is almost a certainty that a computer could be constructed which would follow this theory, and, therefore, could obtain the greatest possible tonnage with all limitations considered. Naturally, the electrical and mechanical equipment manufacturers stand ready to assist, but it is primarily the user who is most familiar with the process, and is, therefore, in a position to examine and study it.

SUMMARY

There will be terrific advances in this area of automation in the next few years. As indicated, these advances will not come about automatically, but will require great effort from both equipment manufacturers and steelmakers. However, if we do a good job, the payoff will be worth it.

Today, each process equipment has enormous production capabilities, and a greater capital expenditure is required for each new facility. As a result there is not only a desire, but a necessity for better control of production and quality. Economic pressures exist to accelerate the evolution from mechanization to automation. Long range planning becomes ever more important. Processes and drive systems need to be reviewed in terms of our expanding technology to be sure that today's expansion and modernization programs represent desirable and wise contributions to tomorrow's operations. ▲

Available Translations

As a service to readers of the *Iron and Steel Engineer*, a list of translations from foreign articles is being printed intermittently. Articles selected for this listing will be those thought to be of primary interest to the American steel plant operator. Those papers listed with a number only may be obtained from the Cooperative Translation Service, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S. W. 1, England. The titles with a BT in front of the number may be obtained from H. Brutcher, P.O. Box 157, Altadena, California, U.S.A. All correspondence concerning price, ordering, and so forth should be directed to one of the preceding sources.

BT 4019 DUBROV: "Ways of Minimizing Edge Cracks (in Rolling of Electrical Sheet)," *Metallurg*, 1956, vol. 1, No. 12, pp. 23–24.

BT 4051 BOICHENKO: "Effect of Heating of the Blast upon the Working of a Blast-furnace," *Stal'*, 1957, No. 6, pp. 483–486.

733 HAMMER, et al.: "The Mechanism of Top Blowing," *Stahl u. Eisen*, 1957, vol. 77, No. 19, 19th Sept., pp. 1303–1308.

737 NASE: "Dust Removal in a Pallet Sintering Plant," *Stahl u. Eisen*, 1957, vol. 77, Aug. 8th, pp. 1070–1074.

833 NEKRASOV: "Soviet Blast-furnace Production," *Stal'*, 1957, Nov., pp. 965–968.

616 BAAKE and STOLLBERG: "Results of New Studies made with O. H. Furnaces, and particularly with those of the Maertz type," *Neue Hütte*, 1957, No. 2/3, Feb./Mar., pp. 157–168.

820 KALLING and JOHANSSON: "Refining with Oxygen in the Rotary Furnace according to the Kaldo Process," *Stahl u. Eisen*, 1957, Dec. 26th, pp. 1885–1887. (This paper supplements the report published in *Stahl u. Eisen*, 1957, pp. 1308–1315, and includes discussion.)

862 NECHAEV: "Gas Turbines as Direct Sources of Blast-furnace Blast," *Stal'*, 1957, Dec., pp. 1140–1141.

BT 3836 PATKOVSKII: "New Trends in the Design of Sinter Plants," *Stal'*, 1955, vol. 15, No. 3, pp. 208–215.

BT 4056 SEL'KIN and ZADALYA: "Prevention of Brown Fumes when Blowing Oxygen through Steel Baths," *Stal'*, 1957, vol. 17, pp. 884–887.

BT 4058 DNEPRENKO and IOFFE: "Prevention of Decarburization of Alloy Steels during Annealing in Controlled Atmospheres," *Stal'*, 1957, vol. 17, pp. 934–935.

BT 4061 RADTSIG and BURK-LEVINSON: "Neutralization of Spent Pickle Liquor with Lime Sludge or Ground Lime, Coupled with Production of Heat-insulating Materials," *Stal'*, 1957, vol. 17, pp. 858–860.

804 NEUMANN: "Application of the Cold Pilger Process and Comparison with Cold Drawing, *Z. Metallk.*, 1957, vol. 48, Oct., pp. 564–568.

823 SPEITH et al.: "Desulphurisation in the Basic Open-hearth Process," *Stahl u. Eisen*, 1958, vol. 78, Jan. 9th, pp. 27–34.

826 SCHWARZMAIER: "Continuous Casting of Tubes," Extracts from "Stranggiessen-Entwicklung u. Anwendung," Berliner Union, G.m.b.H., Stuttgart, 1957, pp. 146–161.

848 PARIS, et al.: "Belt Conveyors in the Iron and Steel Industry."

849 VIERLING: "Transport by Conveyor Belts in Iron and Steel Works."

BT 4049 HOLTHEN: "Metal Colouring," Part II—"Colouring of Iron and Steel," *Metallwarenind. u. Galvanotechnik*, 1957, vol. 48, May, pp. 214–215.

BT 4100 LUEG, et al.: "Study of Oils and Emulsions for Lubrication" in Cold-rolling Trials," Part I. *Stahl u. Eisen*, 1957, vol. 77, pp. 1817–1830.

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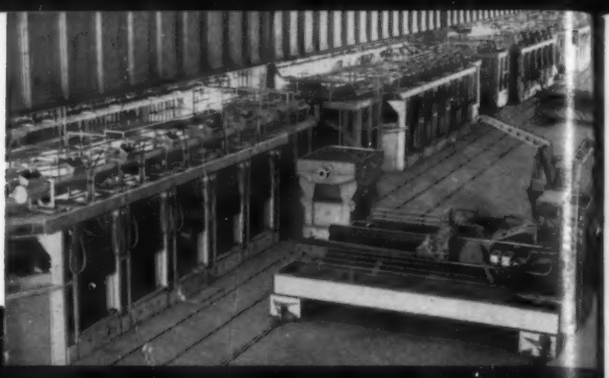

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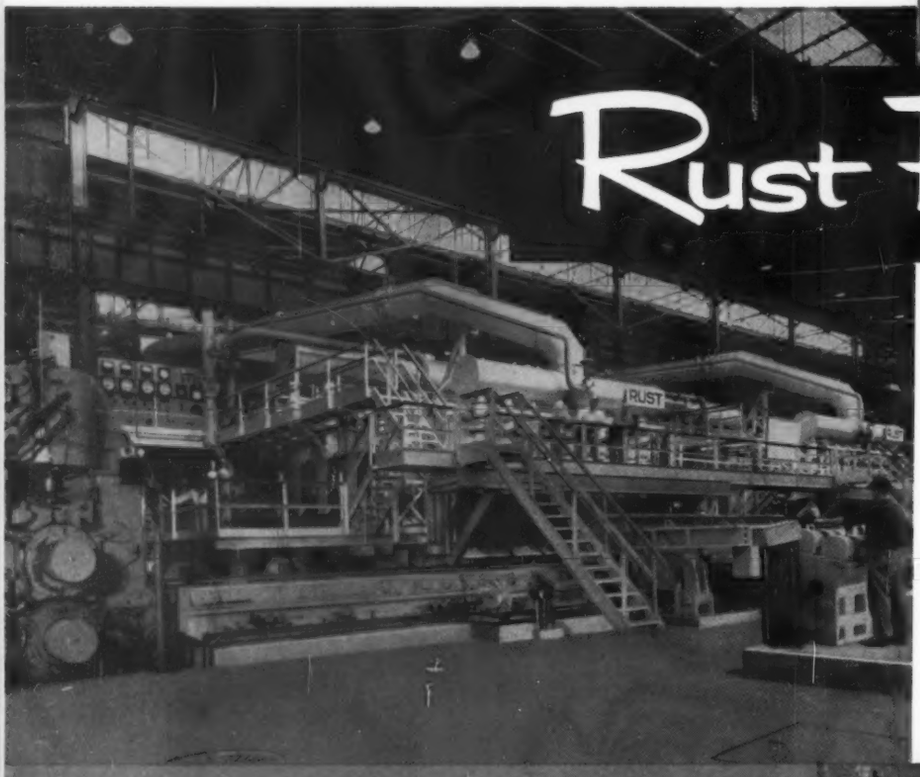

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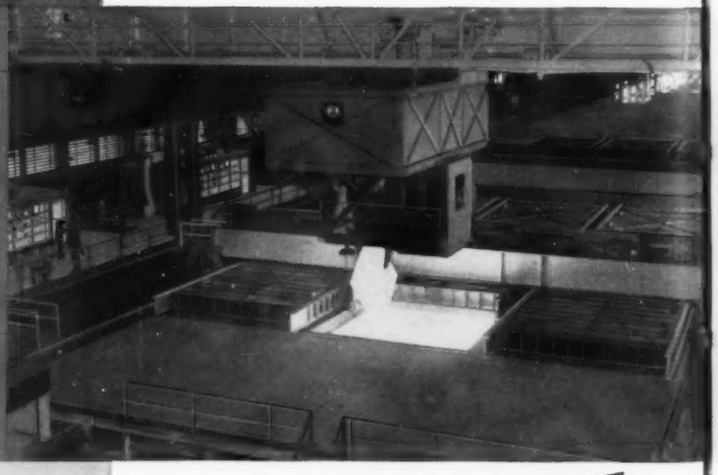

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CECO Steel to Erect Steel Mill in Illinois

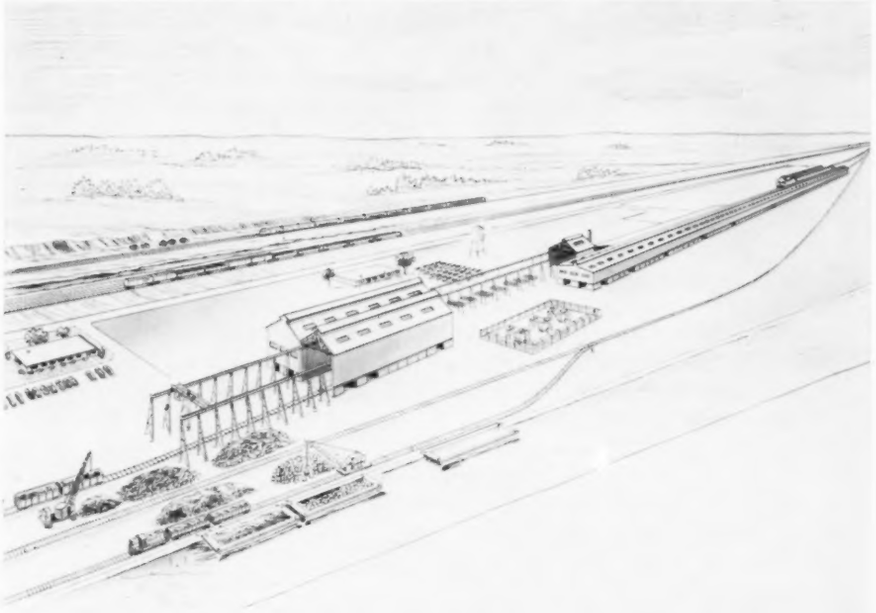
CECO Steel Products Corp. will erect an $11,000,000 bar steel mill at Lemont, Ill., Ned A. Ochiltree, president, announced on May 5, 1958.

The Chicago fabricating company, one of the nation's largest suppliers of structural and related steel products for the construction industry, will produce steel in the new plant under the name of Lemont Manufacturing Corp., a new wholly-owned subsidiary.

The entire output of the bar mill, which will have a capacity of 120,000 net tons of billet-sized ingots per year, will be used by Ceco, and not sold to other fabricators. Mill is of cross-country type and will have one 18-in., 3-high stand; one 14-in., two-high stand; four 12-in. two-high, and two 10-in (one vertical) two-high stands for finishing. In addition, for continuous looping and repeating continuous mill practice, there is a tandem continuous four stand, 14-in. unit which can be cut into line for the production of the smaller bar sections.

The proposed production facilities will be located on an 88-acre tract two miles west of Lemont and will have a mile and one-half frontage on the Santa Fe Railroad to the south and on the Chicago Sanitary Ship Canal to the north. The site is 27 miles southwest of Chicago.

Figure 1 — Artist's concept of new steel plant.



Structures to be erected include an electric melt shop with two 12-ft 18-ton heat electric arc furnaces and provision for a third, a rolling mill, and service buildings—a total of 141,230 sq ft under roof. Additional areas under craneways and unroofed outdoor work areas total 198,000 sq ft, making nearly 340,000 sq ft of production facilities in all.

Three miles of railroad siding on the site will handle 35 freight cars in and out per day. More than two miles of private paved roadway will serve the plant.

With near automated equipment, the plant will employ 210 persons.

The mill is expected to be in operation by the fall of 1959 and running at capacity by 1960. It will be capable of producing a wide variety of products including small structural shapes such as channels and angles, rounds from $\frac{3}{8}$ to $2\frac{1}{4}$ in. diam, all sizes of reinforcing bars for concrete, and special sections used in architectural building applications.

Loans totaling $11,000,000 from five life insurance companies have been arranged. In addition, outstanding bank loans are being increased by $1,600,000 to help provide working capital for the new plant. Of the more than 300,000 tons of steel now bought a year, the Lemont plant will supply one-third to one-half of needs, so Ceco will continue to purchase some finished steel from present sources. However, accessibility to rail and barge transportation will enable providing faster, better service more economically to the market area throughout the Mississippi basin and Gulf area.

The bar mill will use scrap steel and the area surrounding Chicago is the largest steel scrap market in the United States. The new mill will consume approximately 75,000,000 kwhr of electric power annually and will use natural gas for its billet reheating furnaces in warm weather and fuel oil in cold weather.

Engineer and constructors for the Lemont plant are the Rust Engineering Co., Pittsburgh, Pa. Home office of Ceco Steel Products Corp. is at 5601 West 26th Street, Chicago (Cicero). ▲

Granite City Steel Completes $33,000,000 Expansion Program

THE Granite City Steel Co. has completed one of the last and most important projects in its $33,000,000 expansion program by rebuilding two rolling mill units in order to increase its capacity to produce cold rolled steel products by about 30 per cent.

The two units are a 4-stand tandem cold reduction mill that is now one of the most powerful in the steel industry, and a temper or skin pass mill. Ten powerful d-c motors, twice the previous number, now put 18,700 hp into driving the work rolls and tension reel of the cold reduction mill. The long strips of steel leave the last of the four stands at speeds of as much as 40 mphr.

The 30 per cent capacity increase means Granite City Steel can now produce up to 750,000 tons a year of cold rolled steel products. These include cold rolled coils and sheets, electrical sheets, galvanized roofing and siding and galvanized sheets, tinplate and tin mill black plate. The added capacity will give the company more flexibility in scheduling and shipping cold rolled products to customers in its Midwest, South and Southwest market area.

The improvements to both rolling units involved substantial construction and electrical work. This was done on an around-the-clock basis, as Granite City Steel could not produce cold rolled products while the cold reduction mill was shut down. It was estimated that the cold mill rebuilding would require about five weeks, but it was completed in a week less than that period—and customers were supplied meanwhile from an inventory rolled prior to the shutdown.

This was one of the most carefully scheduled expansion projects Granite City Steel has ever undertaken, everything possible was done in advance. For example, 72 per cent of the 78,834 construction manhours required on the tandem cold mill job was completed before the mill was shut down.

The pre-shutdown work on the cold mill included the installation of a new 8500-hp, 6000-kw motor-generator set for the 10 mill drive motors, and the modification of an existing 12,000-hp motor-generator set to increase its kw output from 7750 to 9250. It also included the installation of about 40,000 ft of wire and 6550 ft of heavy copper bus bar to carry the mill's additional power requirements, the pre-fabrication of steel beam motor bases and the sinking of concrete pilings, and much of the work on a 24-in. high-pressure pipeline that will carry 5000 gpm of water from the company's reservoir a distance of 1500 ft to the cold mill, where it will be used to cool the mill's rolls while it is operating.

The cold mill was also equipped with a more precise control system by the installation of sensitive magnetic amplifiers to govern the controls that regulate the speeds of the work rolls in each of the four stands. In addition, an x-ray gage was installed to furnish a constant measurement of the thickness of the strip as it races out of the last stand. Steel entering the mill as it unrolls from a heavy coil is usually from 0.074 to 0.125 in. thick. Leaving the fourth stand, it will be as thin as 0.0085 of an inch.

Additional time was saved during the shutdown of the cold mill by the use of a 3000 F, oxygen flame—enriched by the rapid oxidation of a mixture of iron flakes and aluminum powder—to cut or melt away a large area of reinforced concrete. Usually, this would have been removed more slowly by breaking it up with jackhammers.

The other major improvement just completed at Granite City Steel was an increase to 3200 hp in the motors that drive the company's 56-in. temper or skin pass mill. This mill, which weighs more than 300 tons, was also disassembled and moved to a new building to tie its operation in more closely with other finishing processes. Its control system was improved by the installation of magnetic amplifier regulators.

The temper mill, one of two at Granite City Steel, is used to restore springiness, flatness and surface hardness to cold rolled steel that has been treated in an annealing furnace.

The work on the cold reduction mill was handled by Granite City Steel's own construction forces. The Fruin-Colnon Contracting Co. was the general contractor on the temper mill job, and on the laying of the 24-in. water pipeline to the cold reduction mill. The engineering of both projects was handled by the company's own engineering department, and the drawings for the cold reduction mill project alone required more than 14,700 engineering man-hours.

Granite City Steel produces hot rolled sheets and plates as well as cold rolled products. Its main office, blast furnaces, open hearth furnaces, rolling mills and finishing equipment are located on a 550-acre plant area in Granite City, Ill., across the Mississippi River from St. Louis. ▲

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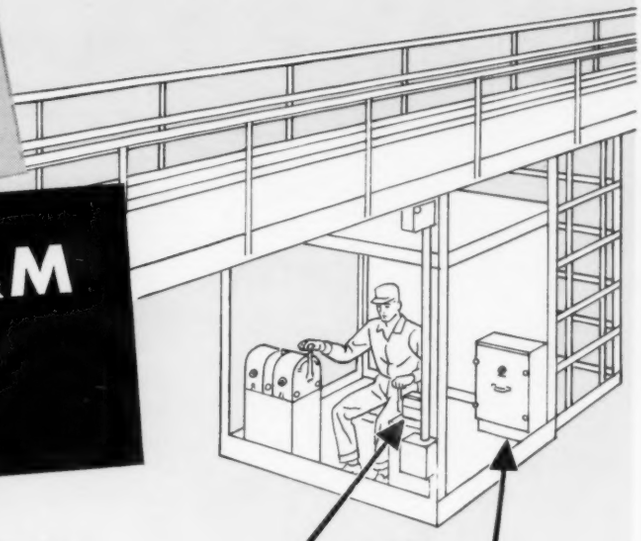

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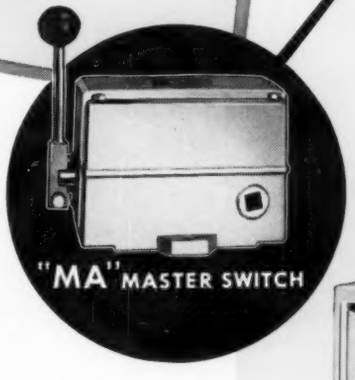

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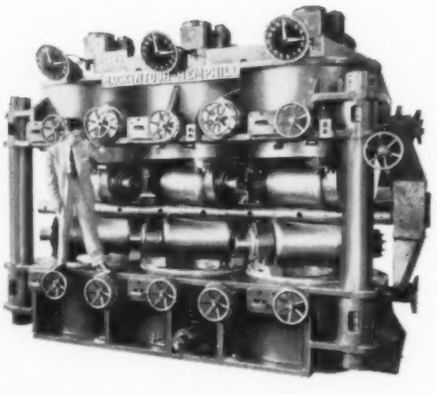

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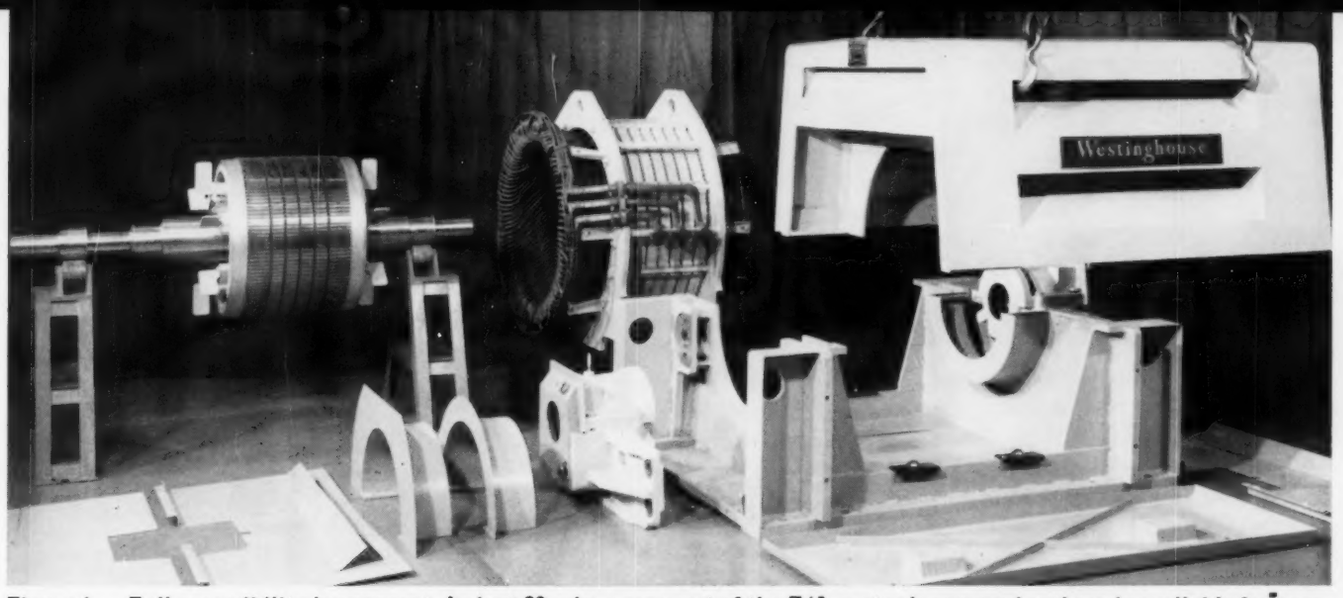


Figure 1 — Full accessibility is apparent. In just 30 min, every part of the F/A motor is removed and made available for complete inspection, cleaning and general servicing. In reassembly, all parts go together correctly.

Large A-C Motors Feature Accessibility

A NEW concept in the design of large a-c motors has been announced by the Westinghouse Electric Corp. For the first time, the new motor design, called F/A (Fully Accessible) motor, permits the enclosure to be manufactured independent of the wound stator. Now, during assembly, the enclosure is merely bolted to the base of the motor making the wound stator fully accessible when required. Previously, the enclosure was welded or cast as part of the wound stator, limiting accessibility.

As a result, the complete line of Westinghouse squirrel-cage, wound rotor, and synchronous motors from 250 to 7000 hp (depending on speed) for all horizontal utility and industrial drive applications have been redesigned to use only six basic enclosures and 30 frame sizes as compared to 450 frame sizes formerly used.

Key advantages of the Westinghouse F/A motor design are:

1. The stator is accessible for thorough inspection. Enclosures are quickly removed, easily replaced and require no realinement.

2. The protruding conduit box is eliminated.

3. Noise mufflers, air filters and all types of accessories can be added to the F/A motor without any redesign of basic parts.

4. Standardization is now possible, because each F/A motor frame size replaces 16 of the previous line.

5. The purchaser gets immediate service on outline drawings, and faster service on replacement parts.

6. The user gains in quality because of precision manufacturing methods.

Figure 2 — For inspection, the wound stator can at any time be separated from the base of the motor by just unfastening four bolts from a specially designed joint piece. When the wound stator is reassembled, the proper air gap is maintained because realinement is not required.

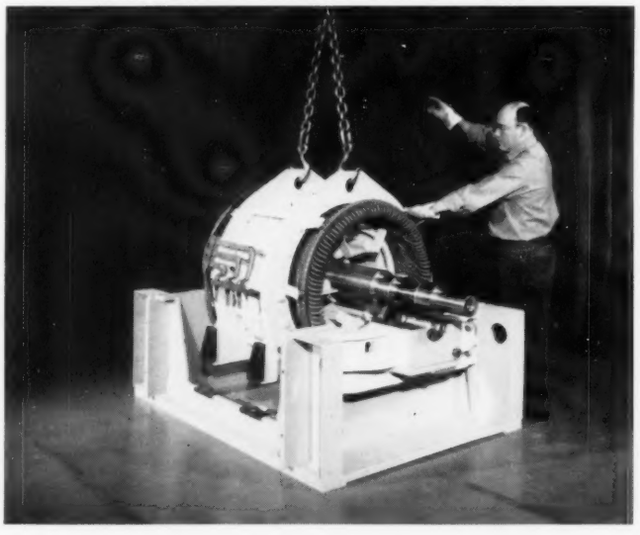
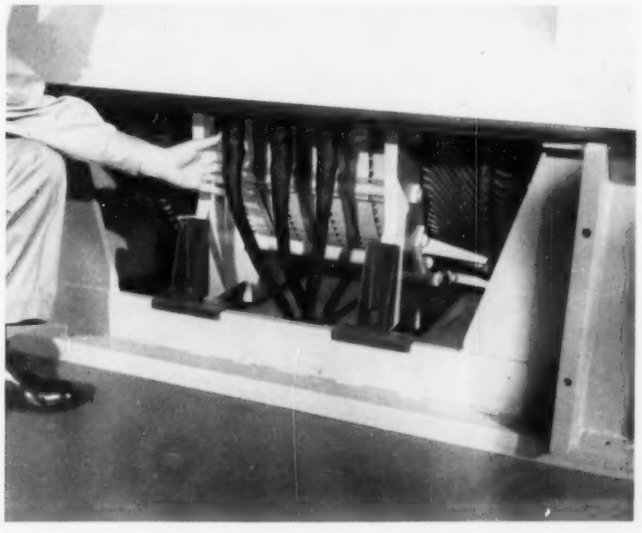


Figure 3 — The side panel of the F/A motor is easily removed. The conduit and line leads enter through an opening in the base of the motor. A large area is available for making connections, eliminating the crowded, protruding conduit box.



7. The F/A motors can be delivered faster because of improved production schedules.

The fundamental principle of electrical maintenance is to keep the apparatus clean and dry. This principle is especially true in locations where oil vapor, carbon dust, and other conducting material are prevalent. With the F/A motor design, cleaning and drying are done with ease. All the motor parts, end panels, end covers, and enclosure itself, can be easily removed from the base in a matter of minutes. Real freedom is achieved for close inspection of all internal parts. The base remains shimmed and doweled in place during disassembly and reassembly. Previously, inspection was limited to a restricted look at the motor ends.

The wound stator of the F/A motor is accurately positioned on the base to give the correct air gap, and is held solidly in place by four stator-base locator joints. The bottom part of each joint is welded to the base, and the upper part is welded to the stator. When the stator is removed for more detailed inspection, the bolt holding the two parts together is unfastened from each of the four locator joints. On replacing the wound stator, it can only go together correctly.

Because removal of the side panels gives ample room inside the F/A motor for motor lead connections, no conduit box is needed. The conduit and line leads enter through an opening in the base of the motor. Appropriate size conduit holes are either drilled or punched in a removable coverplate. The plates are then reinstalled, and the proper conduit connections are made.

In recent years, the reduction of large a-c motor noise levels has been a major development project. The F/A motor design permits a reduction of sound level after installation without redesigning, because noise mufflers and motor were developed to match with very gratifying test results. Where other large motors have been developed for use with noise mufflers, only the F/A motor has isolated the wound stator from the enclosure to overcome transmission of magnetic vibrations and noise.

The flexible design of the F/A motor makes standardization practical. For example, the two smallest frame sizes of the F/A motor now replace 16 frame sizes of the squirrel-cage motors, 16 frame sizes of the wound-rotor motors and 8 frame sizes of the synchronous motors. Reducing the number of frame sizes from 450 to only 30 offers many customer advantages: (1) identification of outline dimensions without calculating a design; (2) the user gains in quality because of precision manufacturing methods; and (3) improved production schedules make faster delivery of motors possible since more parts are stocked during low load periods and used from stock during peak load periods.

Another feature of the F/A motor design is the shorter manufacturing period. Similar to the automobile, the parts move in parallel to the assembly floor rather than in series as was the case when the wound stator and enclosure were a single unit. The most critical manufacturing operation, winding the stator, is easily done since access to the stator is not limited by a surrounding enclosure. The proper air gap is obtained by merely adjusting the stator. ▲

Republic Steel Puts Order Processing System Into Operation

REPUBLIC Steel has announced the completion of a new order processing system which combines the latest in electronics with a unique corps of "minute men" to expedite the flow of information from customer to mill.

The new system is described as the fastest and most efficient system for handling customer orders and inquiries of any steel company in the country.

Under the new system of operating its nationwide network of teletypewriters by electronically punched tape, a mail order form, complete in every detail, can be placed on the mill the same day it is received at a district sales office—hundreds or perhaps even thousands of miles away.

In the past, up to a week was required between receipt of an order and scheduling at the mill.

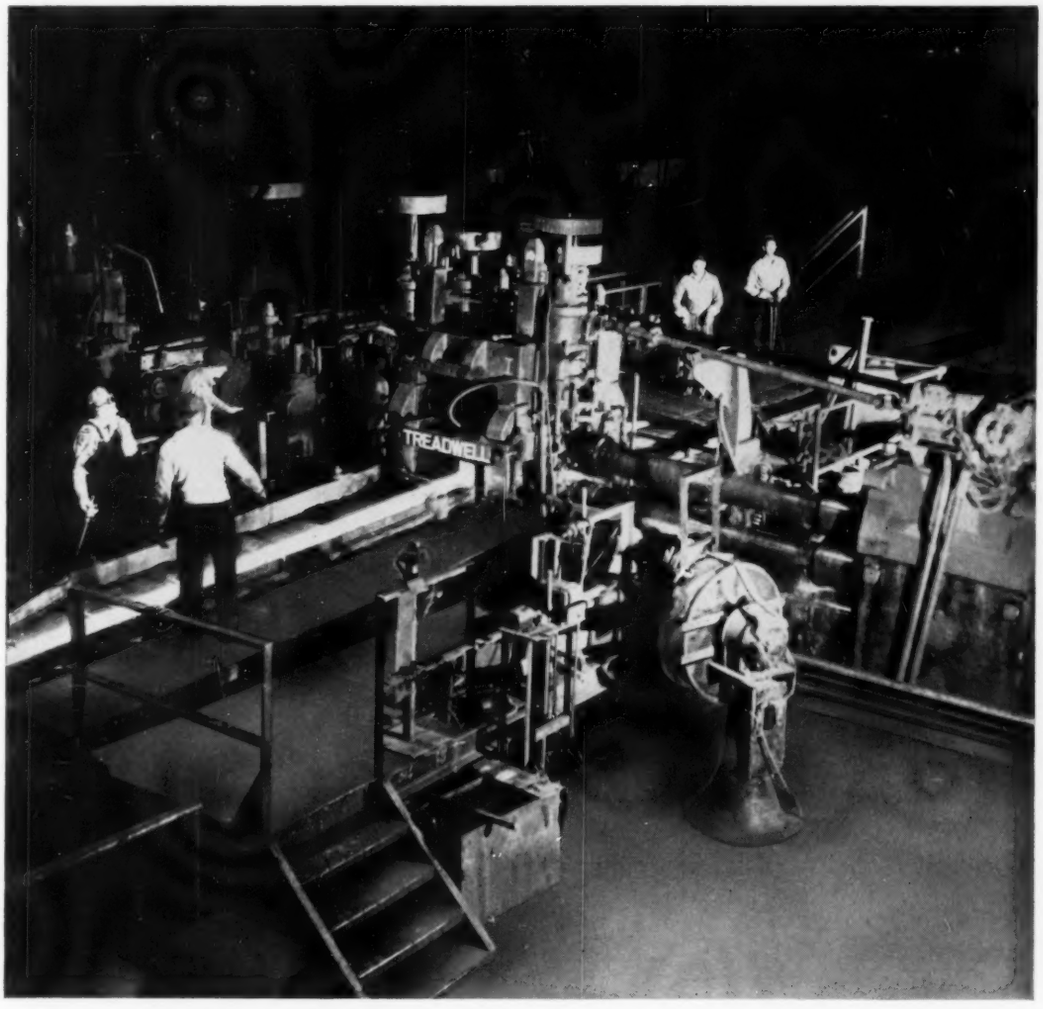
The new system links district sales offices to centrally located "service" centers where customers' inquiries are answered, and where orders are processed and scheduled to producing mills.

It is in these service centers where teams of vitally important, specially trained order-processing "minute men" work in desk-to-desk proximity, clearing and assigning orders to the Republic mill which can handle them most quickly and efficiently.

Republic believes that by having all inquiries and orders clear through central service centers where the detailed situation at each mill unit is consolidated into a total picture, they are in a position to provide better service. However, it is only by using the best of modern communication equipment that the centralization becomes possible.

Each team is made up of a metallurgist, a sales order expert, and a mill schedule specialist. The value of their ability to pool highly technical knowledge at a moment's notice is heightened even further by the fact that they are invested with definite authority. They can reassign orders to the most available mill; advise the mill of peculiar quality requirements and establish production priority.

Treadwell



Manipulators, Mill, etc.
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Mills, Merchant & Bar
Mills, Rod
Mills, Sheet
Mills, Strip (Cold)
Mills, Strip (Hot) & Skelp
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Tables, Tilting & Lift
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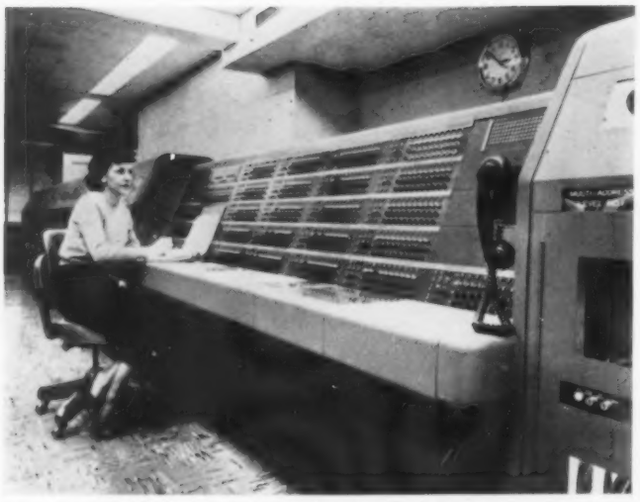

Figure 1 (left) — Machines which can "read" and generate a punched paper tape are the heart of Republic Steel Corp.'s newly completed electronic order processing system which has been installed at a cost of $1,000,000. Figure 2 (right) — This small electronic tape and single order form does away with 33 forms previously needed in processing an order. The electronic tape which automatically actuates Republic Steel's nationwide network of teletypewriters is the heart of the company's new million-dollar automated order service system.

Called the Order Service System, the new procedure is the result of three years of research and experimentation, and brings with it additional advantages. It greatly reduces the possibility of errors in all paper work, and eliminates duplication in record keeping and filing. It also quickly provides statistical information to enable management to better plan and control operations.

This is another step in Republic's program to give the best service possible to its customers and to operate more efficiently. In the last decade the company has appropriated more than $600,000,000 to expand and improve the company's facilities and during this period Republic's dollar volume of sales has more than doubled. As a result office procedures such as order entry, scheduling, billing and other paper work tend to increase in complexity —and importance—as the company expands. Consequently, the new order service system is a logical extension of Republic's continuing modernization program. Looking into the future, this is a most important step toward making available data for the efficient utilization of electronic computers.

The new system takes as a basis Republic's teletype network which was installed in 1937 to link the company's eight basic steel plants and key fabricating plants and district sales offices to the general office in Cleveland.

In addition to expanding this network and incorporating automatic switching, the teletype machines have been provided with special keyboards to allow the duplication of the mill order form, shipping schedules, shipping notices, control records and invoices directly from the teletype machine. The foundation of the system is the ability of the machines to read and generate a punched paper tape.

When the order is first written, the tape is generated by the machine, used to transmit the order to the home office service center and then stored for future use when the customer re-orders the same item.

As the order is received on the machine at the service center, another tape is generated along with paper copy of the order form. This tape is in turn used to transmit the order to the proper mill.

When the order is received at mill level another tape is generated which is used to write shipping notices and eventually the customer's invoice.

In the case of all except new customers, automatic credit and traffic routing information is contained for each order in the master tape. This makes it possible to simplify checks by these departments.

The tape for a particular order is transmitted automatically within a few minutes' time on teletype sending equipment from the sales office to the service center for that product. Republic Sales offices are located in major cities throughout the country.

The speed and efficiency of the new system has made possible a new single basic form for sales, order and billing functions which have replaced 33 different forms used until now. Regardless of product, this multi-purpose form supplies all necessary information and eliminates duplication and chances for error. It was designed with the assistance of form design technicians of Standard Register Company, Dayton, Ohio.

Research and installation of the new system was under the direction of a committee headed by Edwin C. Mausz, who has had 38 years experience in Republic's administrative programs. He supervised the entire program including the setting up of service centers, reorganization of office space and realignment of personnel.

Service centers for pipe and bar products, and for sheet and strip steel products are located in Republic General office in Cleveland. Service centers for cold drawn steels, alloy, stainless and titanium are in operation in Massillon while still another service center for wire products has been completed at Republic's wire division sales headquarters in Chicago.

A major job was to integrate the new system into operations without disrupting normal service. To do this a large scale educational program for employees was conducted. This included many training classes and distribution of 580 training manuals. ▲

ALLEN-BRADLEY *Quality* Reduced Voltage Motor Starters

AUTOMATIC GRAPHITE RESISTOR TYPE

Graphite disc resistors are automatically inserted in series with the squirrel cage motor at starting. These resistors can be steplessly adjusted for motor and load conditions, resulting in remarkably smooth acceleration of the motor.

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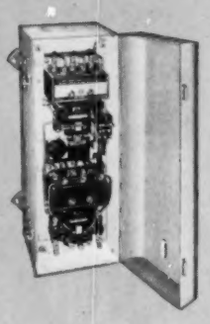

MANUAL STEPLESS RESISTANCE TYPE

Graphite compression disc resistors provide smooth, stepless starting of polyphase squirrel cage motors—prevent lamp flicker. Operated by a hand lever, the smooth starting of the motor is under the control of the operator.

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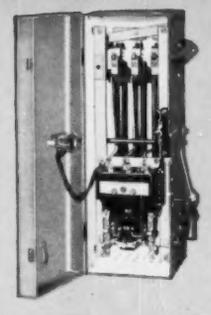

AUTOMATIC MULTIPOINT RESISTANCE TYPE

Meets power company starting current rules on network systems. Resistors are automatically inserted in the line at starting, and are short circuited in steps at definite time intervals which can be adjusted from 1 to 5 seconds.

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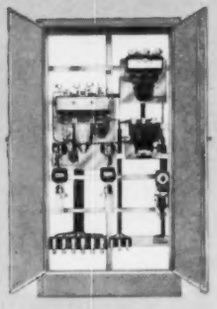

MANUAL AUTOTRANSFORMER TYPE

Recommended where the characteristics of the driven load or power company rules require reduced voltage starting. Double break, silver alloy contacts are standard for air-break starters . . . copper contacts for oil-immersed units.

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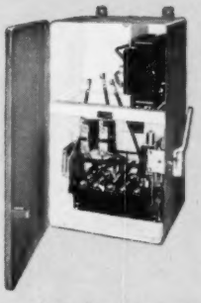

AUTOMATIC STEPLESS GRAPHITE RESISTOR TYPE

The ultimate in velvet smooth acceleration of squirrel cage motors. Lamp flicker on network systems used for both power and light is eliminated. The graphite disc resistors are compressed automatically . . . smoothly and steplessly.

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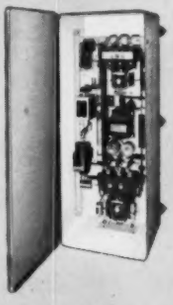
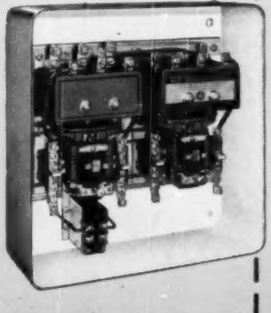


AUTOMATIC PART-WINDING TYPE

For use with squirrel cage motors having two separate parallel stator windings. Two types—Style A, two step starter; Style B, three step starter having resistance in series with motor on the first step.

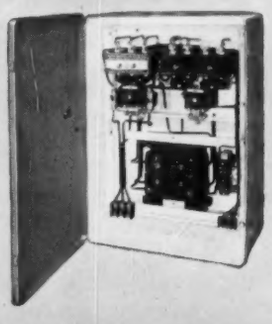
BULLETIN 736



AUTOMATIC AUTOTRANSFORMER TYPE

Utilizes an autotransformer connected in open delta to reduce line voltage for starting squirrel cage motors. Taps are provided on the autotransformer to adjust the voltage applied to the motor.

BULLETIN 746



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Reciprocating Expansion Engine Is Used for Generating Very Cold Temperatures

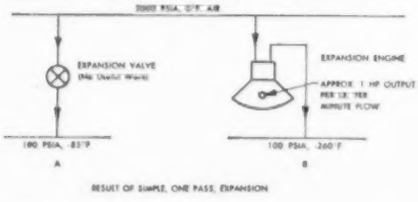
by W. A Morain, Research Engineer, Cooper-Bessemer Corp., Mt. Vernon, Ohio

PROCESS demands for cooling gases to temperatures −100 F and below can be efficiently handled by a reciprocating expansion engine designed and built by The Cooper-Bessemer Corp., Mount Vernon, Ohio. Used in conjunction with a low temperature rectifying column, the reciprocating engine, known as the JX expander, is considered one of the most efficient devices known today for liquefying gases or separating gases by liquefaction. When properly applied, its thermal efficiency is in the order of 75 to 85 per cent.

Designed to develop temperatures as low as −300 F, the expansion engine meets many of the needs anticipated in the cryogenic fields, for example the production of liquid oxygen, nitrogen and other gases.

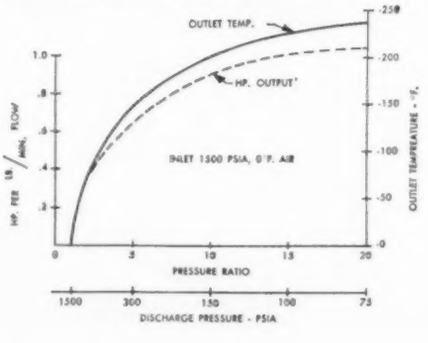
To attain temperatures of −100 F and below it is possible to extend the range of commercial refrigeration cycles based on the vaporization of a liquid (ammonia, freon, etc.) by using two or more fluids in series. It is, however, more practical to make use of the Joule-Thompson effect by expanding through a throttle valve, or a reciprocating or rotating expansion engine. The more efficient means makes use of the expansion of a gas in a machine doing external work. A comparison in efficiencies of the two methods is shown in Figure 1, where air at 3000 psia and 0 F is expanded adiabatically to 100 psia. Resulting temperatures are −85 F and −260 F, illustrating the considerably larger amount of heat that can be removed from the gas in the engine as compared to simple throttling of a gas through an expansion valve where no work of any kind is done. It is, of course, possible to reach very low temperatures with an expansion valve, by recirculation and the use of heat exchangers.

Figure 1 — Sketches compare expansion valve with expansion engine.



RESULT OF SIMPLE, ONE PASS, EXPANSION

Figure 2 — Horsepower output and outlet temperature are given as a function of the pressure ratio.



Cooling cycles employing expansion engines also use heat exchange for continuous processes. In such cases, a much higher efficiency of the cycle using the expansion engine is created by the reduced energy input. For example, cycle efficiencies of 20 to 25 per cent are realized by using reciprocating expansion devices like the JX engine in the production of liquid oxygen. The efficiency is defined as the ratio of the minimum theoretical work for liquefaction to the actual work done.

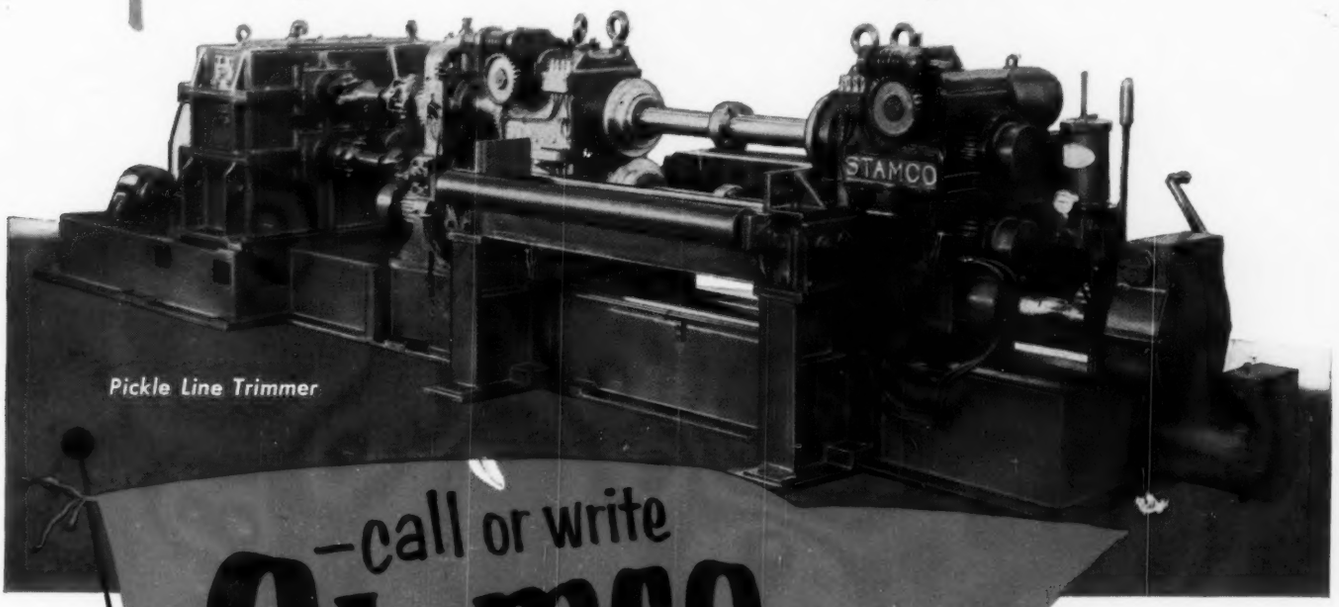
Cycles using only expansion valves average approximately 10 per cent on the same basis.

The amount of cooling obtainable from a reciprocating expansion engine depends on several factors. These are the displacement per minute, inlet conditions, pressure ratio through the expander, and the characteristic of the gas passing through the expansion cycle.

Designed for 3000-psi inlet pressure, the expander passes the greatest flow and is the most effective at this range. Other factors being constant, a reduction of inlet pressure to 1500 psi cuts the flow and refrigeration capacity to slightly less

(*Please turn to page 136*)

for special steel mill operations



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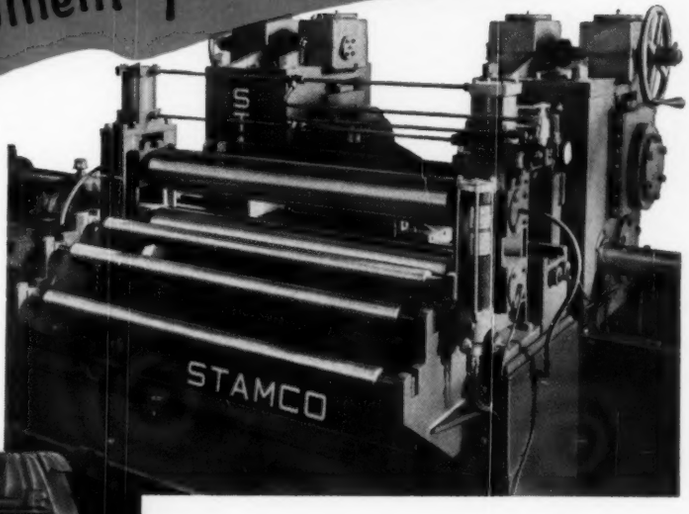

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Fusetron dual-element fuses protected 150 motors against burnout when a hurricane single phased our primary line

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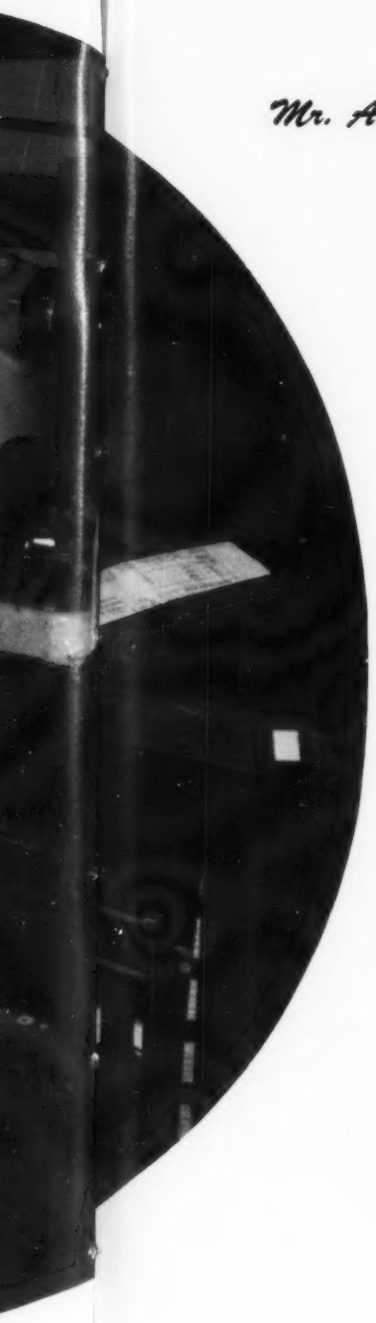

Mr. Ackerman continues . . .

"One afternoon a hurricane struck and single phased the line feeding our plant.

"At the time, all 150 of our sewing machines were in operation. No one suspected the motors were running single phase. Our first warning came when the machines started shutting down through the plant as Fusetron fuses began blowing to protect the motors.

"I had no idea in what condition we would find the motors. It was certainly a relief when we checked and did not find one damaged sewing machine motor. Around 300 Fusetron fuses had blown to protect them.

"You can imagine how costly it would have been to repair or replace these ½ hp., 3 phase, 220 volt motors — and our plant would have been out of business while this work was being done. So we think we paid a very small price when our only expense was replacing the 3-2/10 ampere Fusetron fuses.

"Since this experience, our seven other plants have been informed of the above incident, and it has been suggested to them, that they protect all sewing machine motors with Fusetron dual-element fuses."

Why Fusetron fuses provide safest, simplest way to prevent damage from single phasing.

When single phasing occurs, the current in the remaining phase increases about 100%. (Theoretically 73% but change in efficiency and power factor makes it about 100%.

This 100% overload on Fusetron fuses of motor-running protection size opens them and shuts down the motor.

Such dependable protection against motor burnouts from single phasing has never before been available.

You too, can get maximum electrical protection and save money by installing Fusetron dual-element fuses throughout the plant

With rare exceptions on commercial and industrial installations — ordinary fuses and circuit breakers protect only against short-circuits — but Fusetron dual-element fuses provide 10 point protection.

FOR LOADS ABOVE 600 AMPS. — USE BUSS HI-CAP FUSES TO COORDINATE YOUR ELECTRICAL CIRCUITS.

On 600 volts or less, BUSS Hi-Cap fuses have interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin.

FOR MORE INFORMATION ASK FOR BULLETIN FIS ON FUSETRON DUAL-ELEMENT FUSES — BULLETIN HCS ON BUSS HI-CAP FUSES.

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Play Safe! install FUSETRON dual-element FUSES and BUSS Hi-Cap FUSES throughout entire Electrical System!

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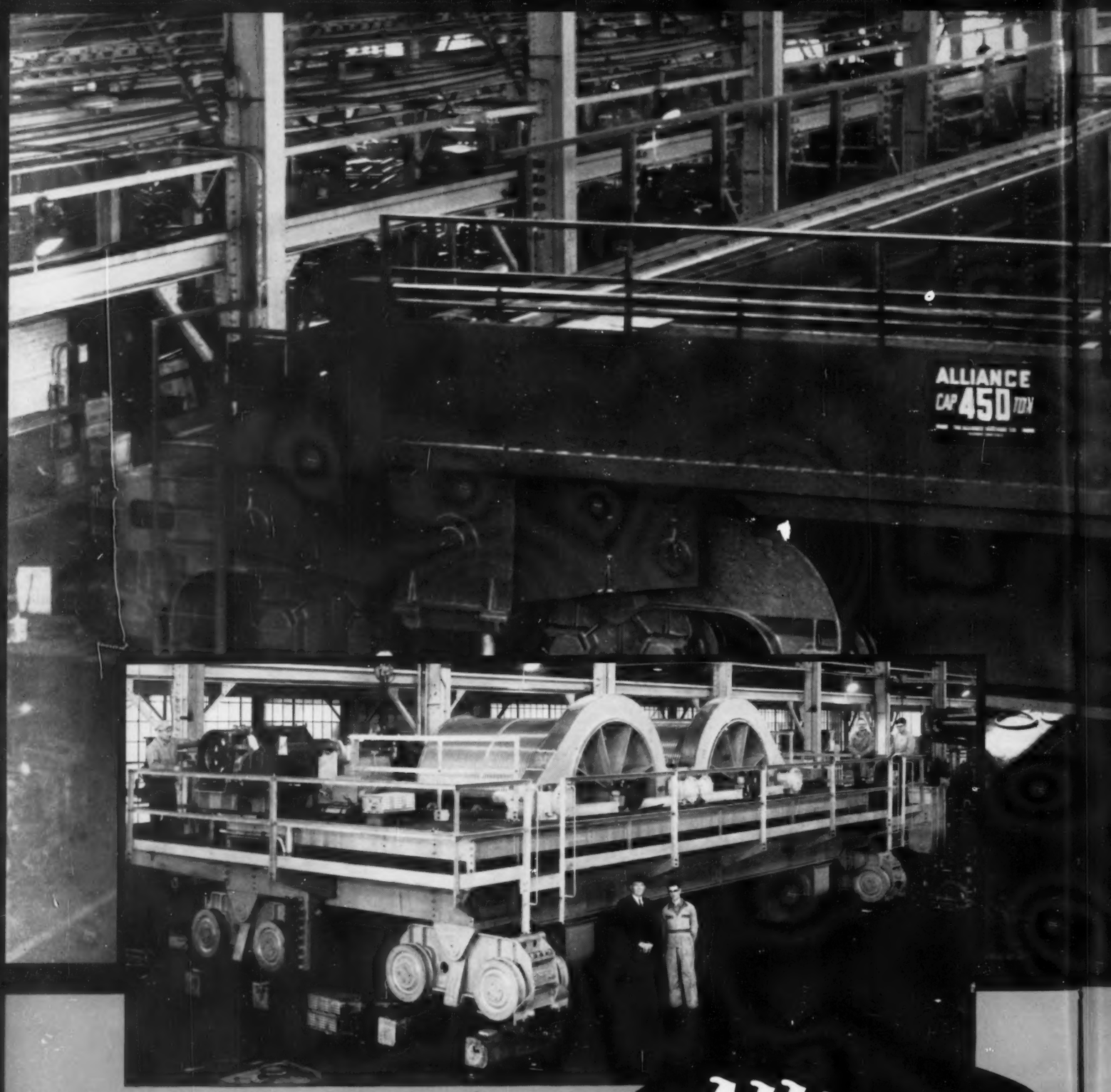

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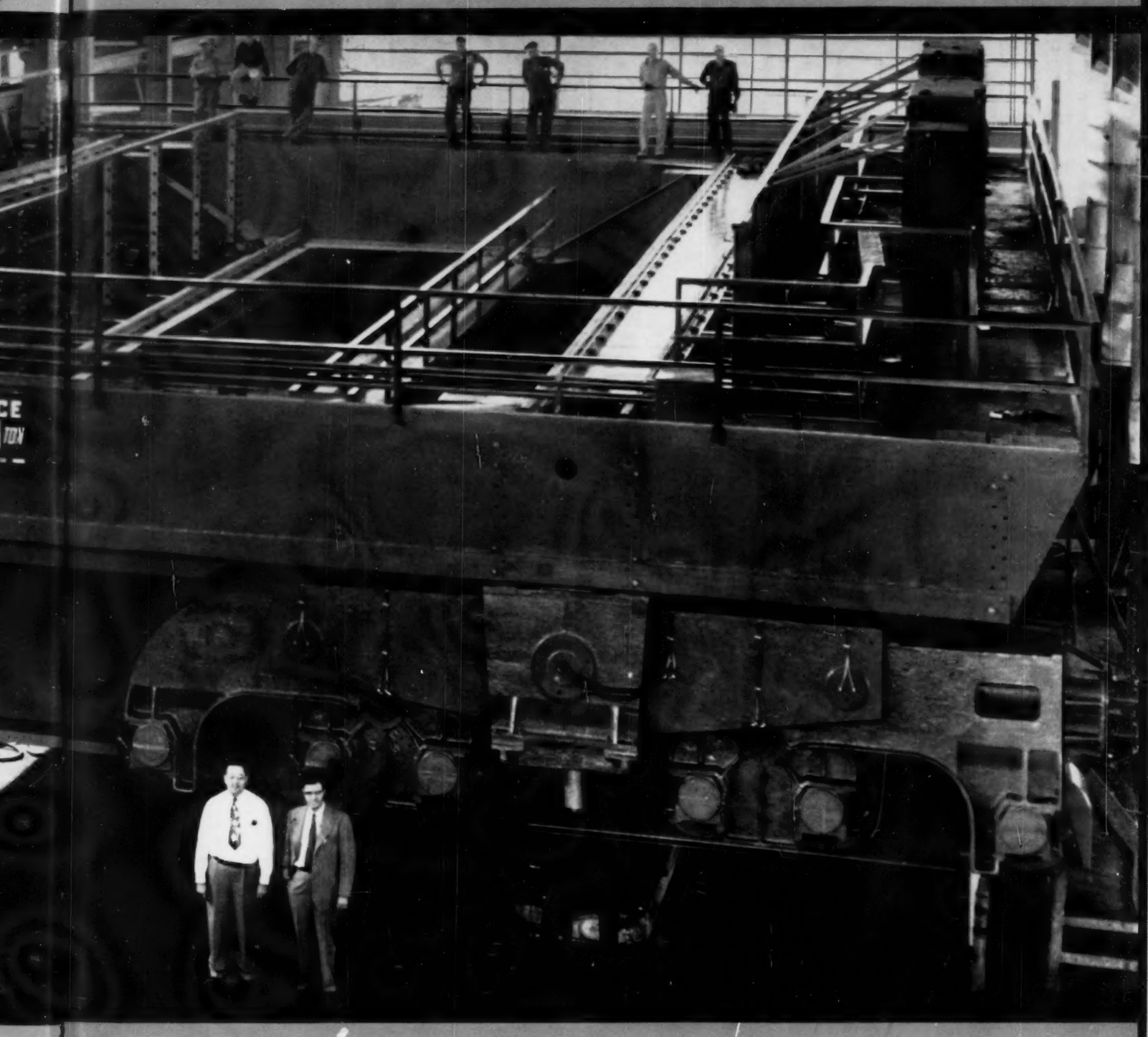

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THE ALLIANCE MACHINE COMPANY
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(*Continued from page 130*)

than half. At inlet pressures of 500 psi and below, it naturally follows that the reciprocating expander engine becomes expensive for the purpose for which it is intended.

A reciprocating expander should be used with a substantial pressure ratio, on the order of 5 to 1 or more. Figure 2 shows horsepower output and outlet temperature as a function of pressure ratio. It is apparent that there is little virtue in using this expansion engine at pressure ratios of 2 or 3 to 1.

It should be noted that the reciprocating expander engine is not designed to handle liquids. The unit, therefore, should not be used where condensates may be formed. Operation under such conditions may result in mechanical damage and ultimately a collapse in thermodynamic efficiency.

One of the more common hazards arises from the fact that most commercial gases contain some impurities which, on expansion to colder temperatures, tend to solidify as fine, abrasive particles in the cylinder. Such particles, by mechanical and/or chemical action shorten the life of the cylinder and rings.

In a great many cases, processors do not refer to the existence of such impurities because of incomplete analytical procedures or because their presence has no importance in the process involved. It has also been found that high boiling point gases, such as the butanes and propane, which liquefy at temperatures from 30 to −45 F, do not remain as simple liquids, but tend to form viscous, glassy spheroids. These condensates can be ruinous to the expander cylinder components in both lubricated and nonlubricated cylinders.

In the processes involving liquefaction or separation of gases by liquefaction of the higher boiling point constituents, the final rectification or separation is carried out in single or double columns containing a large number of plates or trays. It should be made clear that the expansion engine is no substitute for such a rectifying column. The only possible separation that could take place in the engine occurs when a mixture of two gases with widely different boiling points is expanded (for example CH_4 and H_2). Separation of hydrocarbons with relatively close boiling points will not take place, even when temperatures would appear adequately low, because of mutual solubilities.

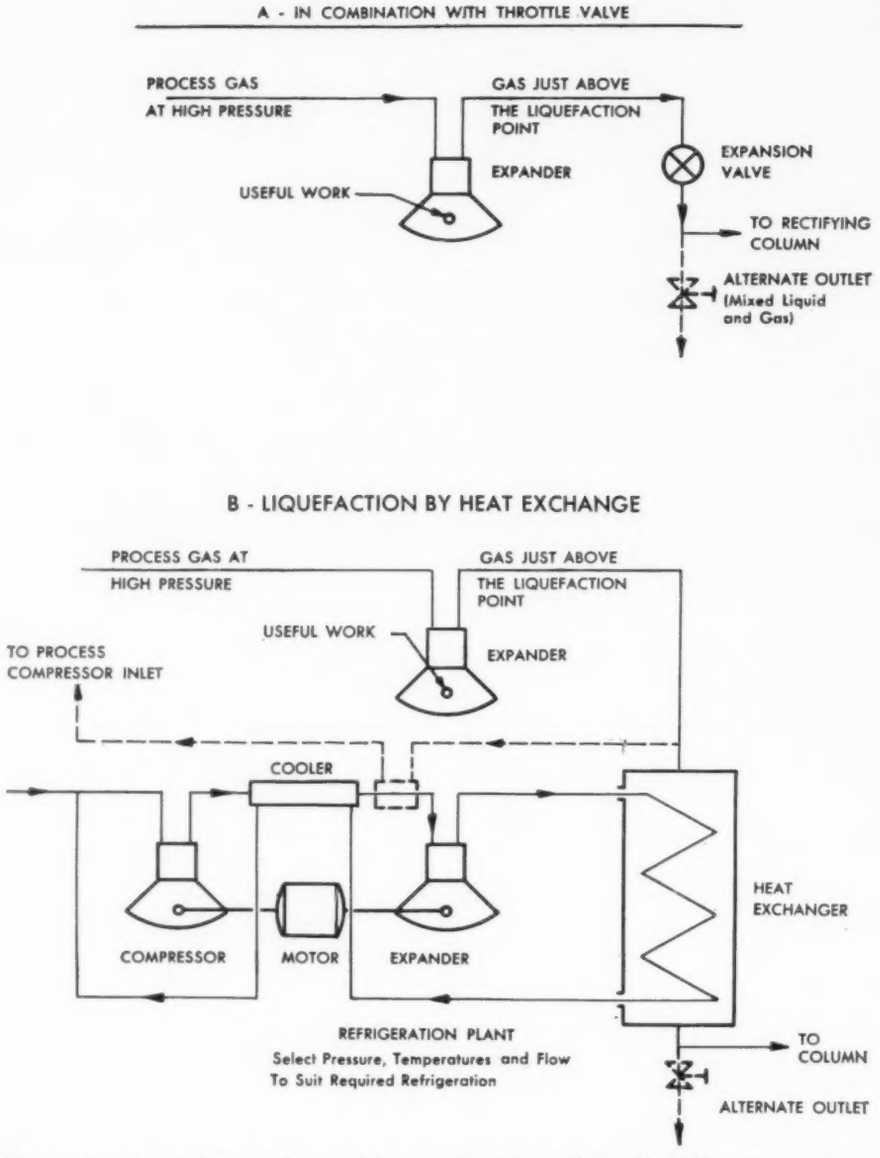

Figure 3 — Expander can be used in combination with a throttle valve or for liquefaction by heat exchange.

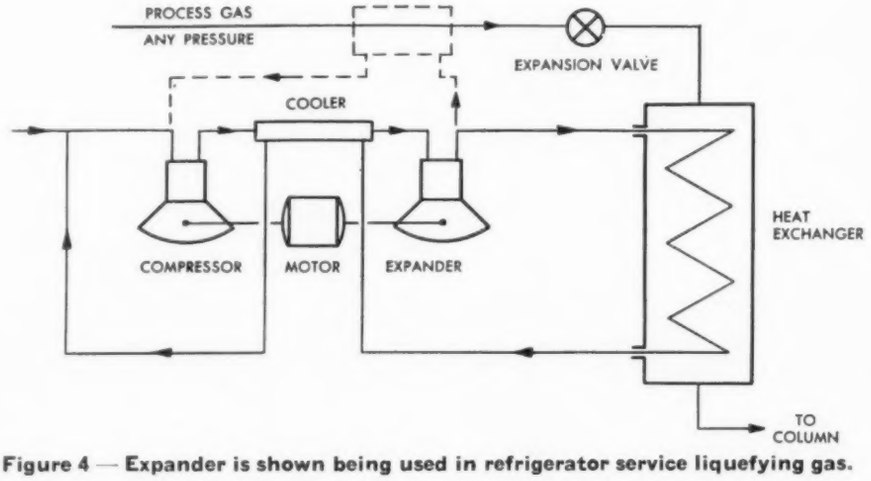

Figure 4 — Expander is shown being used in refrigerator service liquefying gas.

The question at this point is how can an expander be used in such service? There are two entirely practical solutions.

1. The gas mixture can be ex-

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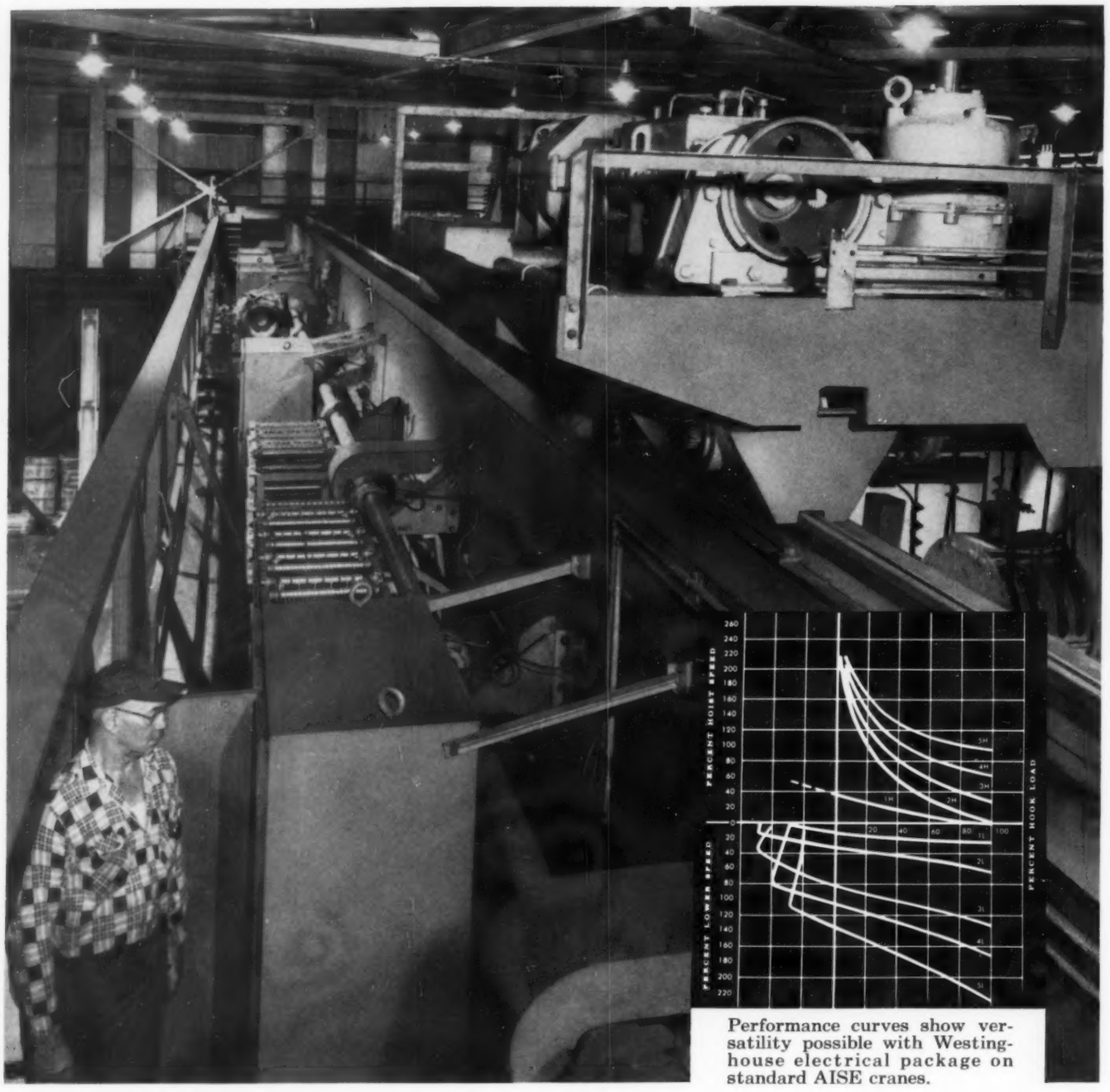

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J-96122

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panded in the engine to some selected pressure where liquefaction is about to occur. The expander discharge can then be further expanded through an expansion valve and thus taken down to the lowest pressure. In this case, the Joule-Thompson effect will provide the final cooling. The already liquefying stream then goes on to the rectifying column, as shown in Figure 3A.

2. The expansion engine can be used as in (1) to ready the product for liquefaction. The discharged gas is then passed through the heat exchanger portion of a refrigeration plant, employing another expander with compressor and associated accessories. In this case, temperatures sufficient for complete liquefaction could be obtained, as shown in Figure 3B.

In the refrigeration cycle shown in Figure 4, process gas can be at relatively low pressure. If the process gas is used in an ordinary mechanical refrigeration cycle, it would be necessary to compress, cool and expand it. The compression and expansion work can be performed on the working fluid in the refrigeration cycle just as well, without loss of efficiency, and thus escape contamination troubles in both systems.

Cycles 3A and 3B are more particularly suited to cases where the process gas exists at high pressure. In certain applications of the expander engine in refrigeration schemes, it may be advantageous to couple it with a freon cycle (at the expander inlet) to obtain minimum temperature and the highest efficiency.

A useful application of the expander engine is in producing refrigeration for large vessels in which physical or chemical processes are being carried out at low temperatures, or simply to cool storage vessels containing liquefied gases to prevent excessive evaporation. Vessels like this are being used more and more industrially. See Figure 5.

It should be mentioned that in handling gas mixtures in the expander engine directly, the final condition is frequently indeterminate. Regardless of any assurance to the contrary, there is still a pronounced lack of information on the thermodynamic behavior of mixed gases and solutions of gases and liquids. The final result often has to wait upon actual tests.

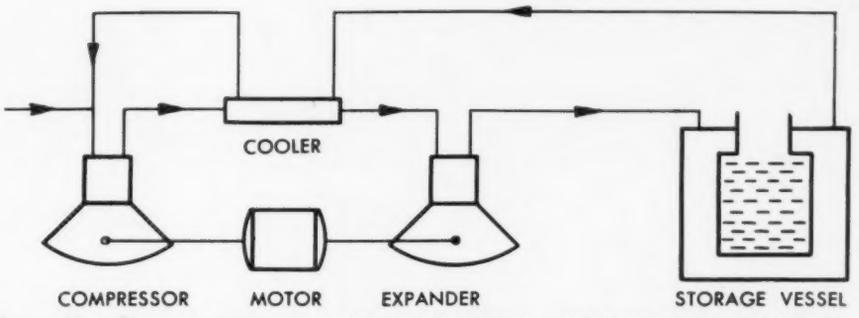


Figure 5 — Expansion engine in this application is used to maintain vessels at very cold temperatures.

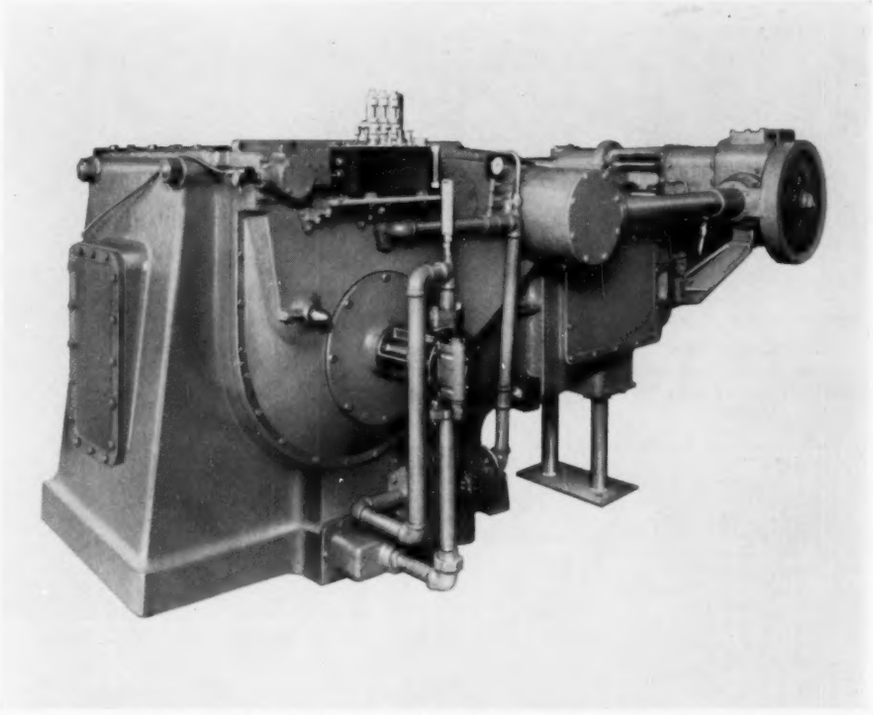


Figure 6 — This expander engine is designed for service in liquefying gases or for separating gases by liquefaction.

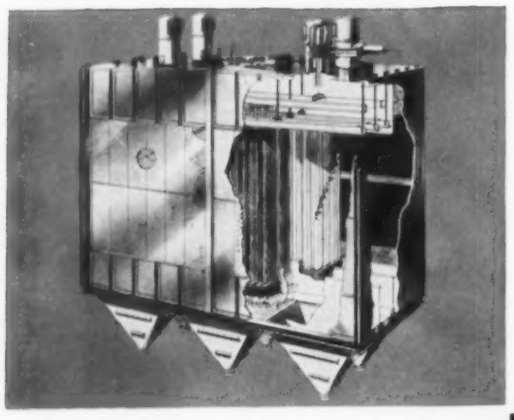
Data on some reciprocating expansion engines are shown in Table I.

All models have horizontal, single acting cylinders, with provision for cylinder and valve packing heating where required. Valves are of poppet type, cam operated. All valve gear is enclosed, and may be pressurized with dry gas if desired, to minimize frosting. All running gear is force-feed lubricated with built-in oil pump, and an attached mechanical lubricator is used to lubricate cylinders and inlet valve packing. Governing may be manual or automatic, and all of the usual protective devices are available. ▲

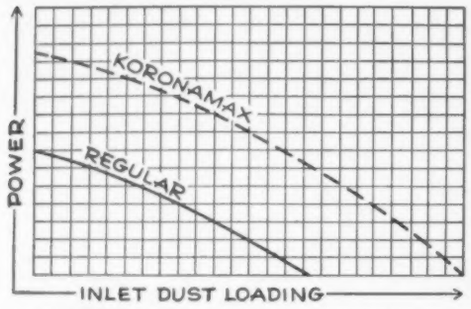
TABLE I
Cooper-Bessemer Reciprocating Expansion Engines

Model	FXA-1	FXA-2	JX-1	JX-2
No. of cylinders	1	2	1	2
Bore and stroke, in.	5 × 10½	5 × 10½	6⅜ × 14	6⅜ × 14
Rated speed, rpm	327	327	257	257
Displacement per revolution, cu in.	206	512	447.5	895
Displacement at rated speed, cfm	39	78	66.5	133
Clearance volume, per cent	5.8	5.8	5.5	5.5
Maximum inlet pressure, psig	3000	3000	3000	3000
Minimum discharge temperature, F	* −275	−275	−275	−275
Cutoff range, per cent stroke	0–50	0–50	0–50	0–50
Over-all length, ft-in.	9–11	9–11	13–10⅞	13–10⅞
Over-all width, ft-in.	4–0	6–4½	5–7½	8–11½
Over-all height, ft-in.	4–4	4–4	5–5⅝	4–5⅝

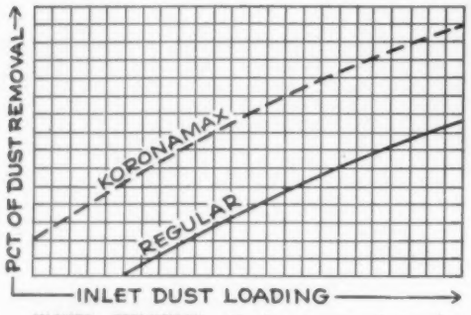
* Lower temperatures available on special order.



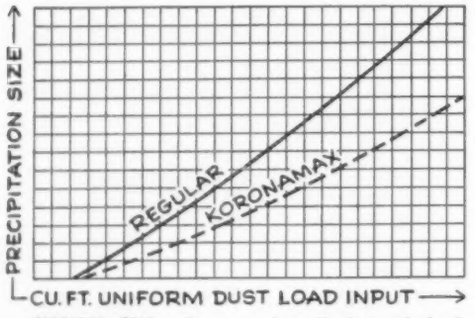
Another Koppers Exclusive in ELECTROSTATIC PRECIPITATION



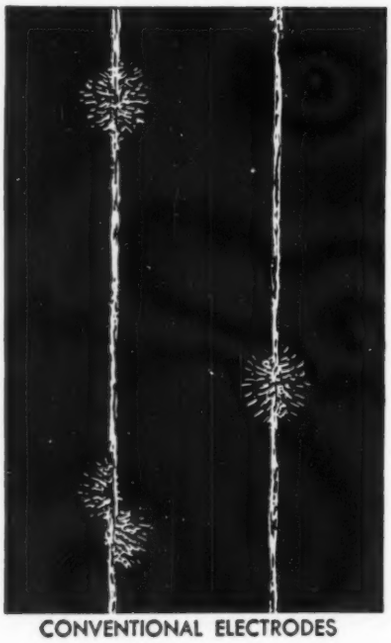
INCREASED POWER—The evenly spaced discharge points of "Koronamax" Electrodes reduce the arc-over tendency and permit increasing power input.



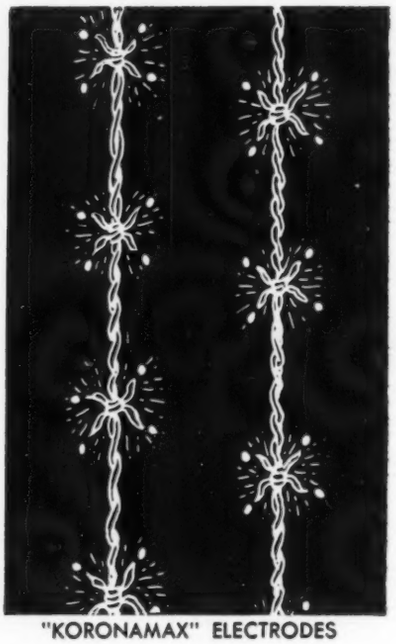
HIGHER EFFICIENCY—Replacement of regular electrodes with "Koronamax" Electrodes allows higher power input — greatly increased efficiency.



SMALLER SIZE—In new installations desired efficiency may be obtained with smaller unit when "Koronamax" Electrodes are used.



CONVENTIONAL ELECTRODES



"KORONAMAX" ELECTRODES

"KORONAMAX" ELECTRODES increase efficiency and capacity of electrostatic precipitators

"Koronamax" Electrodes developed by Koppers are now in service in several different applications and their *controlled* corona discharge has resulted in greatly increased capacity and efficiency. This unique type of precipitator electrode may solve *your* gas cleaning problem.

Koppers' experience, constant research and extensive field testing have led to this important advance in precipitator design. Check with Koppers to see if "Koronamax" Electrodes can help you get top precipitator efficiency. For more information, write: KOPPERS COMPANY, INC., 8306 Scott Street, Baltimore 3, Md.

KOPPERS

ELECTROSTATIC PRECIPITATORS

Engineered Products Sold with ***Service***

Figure 1 — Scrap to be balled is carried in hopper to scrap baller and dumped in front of unit, then raked into baller. Finished balls are palletized for removal to storage area. Hoppers assigned to permanent stations have name of department lettered on side.

Figure 2 — Special three-yard hopper built by Roura Iron Works for Thomas Strip receives balls of copper-coated scrap. Hopper will hold 15 to 18 balls. Balls are loaded into hopper by magnet crane.

Three Point Plan Reduces Scrap Handling

THE Thomas Strip Division of Pittsburgh Steel Co. can prove that scrap handling does not have to be a losing proposition. The company's three-point plan for handling scrap not only keeps the operation business-like but squeezes "extra" profits from the sale of scrap metal.

Scrap at Thomas Strip is produced mainly by slitting, end cutoffs and strapping used to bind coils. Most scrap is uncoated steel, but appreciable quantities of copper, zinc and brass coated scrap are handled.

The three-point plan followed in handling this material is a simple one, but it is adhered to closely to obtain maximum benefits. The three points are these:

1. All scrap is segregated according to the type of coating. This is done for two reasons. First, segregated scrap brings a higher price from the scrap dealer. Second, it permits accurate record keeping as to just how much of what type of scrap is produced each month.

2. All scrap strip less than 15 in. wide is balled in a scrap baller. Again, this brings in extra dollars per ton because dealers pay more for easily-handled balled scrap.

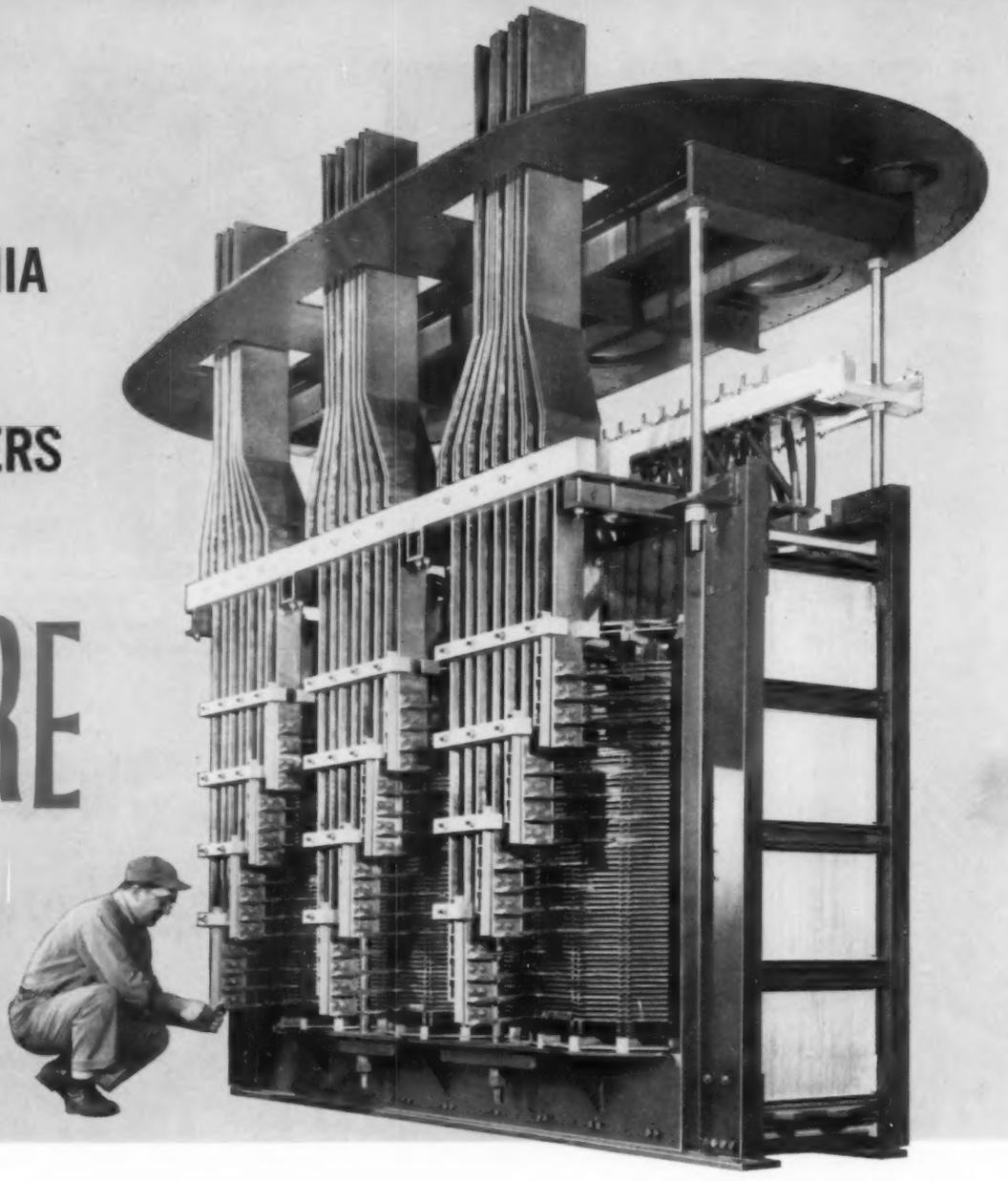
3. The equipment and techniques used to handle scrap are deliberately kept simple and inexpensive. As Works Manager A. E. Gregg puts it: "There would be no point in emphasizing scrap salvage as we do if our methods for collecting and handling scrap were so elaborate as to cost more than the salvage profit."

HOPPERS FOR HANDLING

Essential to the scrap handling technique is the use of self-dumping Roura hoppers for collection and transportation of scrap, regardless of whether the scrap is coated or uncoated, balled or handled in bulk. The steel hoppers range in capacity from three-quarter yard to three yards, and most of the 40 hoppers the company uses are mounted on casters so that they can be moved about easily. Thirty hoppers are stationed in specific locations; the others are moved about as needed. On short hauls the hoppers are moved manually; on long hauls fork trucks move the units.

Although the quantities of scrap produced vary from department to department, the handling pattern is consistent throughout. Scrap is loaded manually into hoppers by the machine operators. (In larger departments hoppers are stationed so that operators do not have to walk more than a few feet to reach them.) When the hopper is full, the department foreman signals a passing fork truck driver to remove the hopper. (Although seemingly casual, this method of pickup works well because there is a fairly heavy flow of fork truck traffic through the plant. If this were not so, a more formal method of arranging for hopper pickup would be required. As it is, the method matches the philosophy of keeping scrap handling uncomplicated.)

How PENNSYLVANIA FURNACE TRANSFORMERS take the TORTURE of Year-in, Year-out Service



Furnace transformers are subjected to repeated short circuits and heavy overloads in ordinary service. Distribution of currents and reduction of copper eddy losses also must be given special consideration.

Throughout the years, Pennsylvania Transformer has earned an unsurpassed reputation for meeting these challenges—in installations ranging from 250 through 25,000 kva, and from 3175 through 82,000 amperes. Here are some of the reasons.

Balanced, Precompressed Coils

Coils are balanced to reduce axial short-circuit forces to a minimum . . . and the circular shape protects the coils against deformation by radial short-circuit forces. Also, coils are precompressed with a pressure equal to the maximum short-circuit force that might occur in service. As a result, no additional distortion or displacement can take place.

Bracing of Coils, Bus Bars

Coils are firmly braced, top and bottom, by clamping plates attached to structural steel frames. The accompanying photograph also shows the sturdy supports used for low voltage bus bars. Interleaving of bus bars tends to counterbalance the lines of force and prevent distortion during short circuits.

Distribution of Current

Because of the heavy secondary currents, the winding is subdivided into numerous parallel sections. Transposition of the individual conductors of each section reduces copper eddy losses to a minimum. This results in improved efficiency, more uniform copper temperature, and prevention of hot spots.

To take advantage of these and other time-proved features of Pennsylvania Furnace Transformers . . . contact Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

NEW EXTERNALLY-MOUNTED TAP CHANGER

Although a duplicate of a previous order, this 12,000-kva Pennsylvania Furnace Transformer differs from its "twin" in one detail. Its motor-driven tap changer is housed in separate compartments, to facilitate periodic inspection and maintenance. The mechanism includes a provision for emergency hand operation.

PENNSYLVANIA FURNACE TRANSFORMERS

pt

McGRAW EDISON

Figure 3 (left)—Scrap handled in bulk is carried in hoppers to the pit at the end of inside rail spur. Pit serves as storage area while scrap is being loaded by magnet crane into gondola cars. When the operator lifts handle on rear of hopper it dumps itself, and automatically locks in an upright position. Figure 4 (right)—At inspection station, zinc-coated steel is checked for gage, width and surface flaws. Cutoffs are thrown into the hopper, which is carried by fork truck to the scrap baller or storage pit.

If the scrap in the hopper is to be balled, the fork truck's trip is a short one. There are two Goughler scrap ballers in the plant, one in the slitting department, the other in the dies department. The fork truck drives to the nearest scrap baller and empties the hopper on the floor in front of the baller. The self-dumping feature of the hoppers makes this a fast operation. The operator simply lifts a lock-handle on the rear of the hopper, the hopper dumps forward, and, when empty, swings back to an upright position and automatically locks itself. It is then returned to its station.

A three-man crew rakes the metal into the scrap baller, and when the ball is ejected, loads it onto a wooden pallet. A fork truck carries full pallets (four balls per pallet) to a storage area alongside an inside rail siding. An overhead magnet crane transfers the balls to storage. When enough balls are accumulated they are loaded, by magnet, aboard a gondola car.

The one exception to this procedure is the handling of balled copper-coated scrap. This is produced in small quantities, and thus must be stored for long intervals while a full shipment is accumulated. Rather than tie up inside storage space, this material is stored outside near the rail siding. A special three-yard capacity hopper moves copper balls to the site. Fabricated by Roura Iron Works, Inc., particularly for the Thomas Strip operation, the hopper was made unusually large (biggest standard Roura hopper is two yards) to reduce the number of handling sequences. It will hold 15 to 18 copper balls. The hopper is kept in the inside storage area, and balls are brought to it by fork truck in the usual method. The magnet crane transfers the balls from pallets to hopper. When the hopper is full it is carried by fork truck to the outside area, dumped (in the same way standard hoppers are emptied), and returned to its station.

LOOSE SCRAP HANDLED IN BULK

About 70 per cent of Thomas Strip's scrap is balled and handled in the manner described above. The remaining 30 per cent—almost all of it uncoated steel scrap strips measuring more than 15 in. wide—is handled and shipped in bulk. Here, too, the hoppers are the primary handling tool. These are loaded manually and carried by fork truck to the storage area paralleling the inside rail siding.

At the end of this siding is a pit measuring 15 ft long, 8 ft wide and 3 ft deep. The self-dumping hoppers are emptied into this pit and returned to their stations. Then the magnet crane transfers the scrap from pit to gondola cars. If this were a continuous operation, the pit would not be necessary, since the crane could handle a hopperload of scrap in a few minutes. But the crane is also used to stock production units, so devotes only part of its time to scrap loading. The pit thus serves as a temporary storage area and prevents scrap from spreading untidily over the warehouse floor.

SCRAP PRODUCED DETERMINES ASSIGNMENT

Assignment of hoppers to permanent stations is determined by the amount of scrap produced in the department. Some locations have one hopper, which is emptied only two or three times a week. Others have several hoppers which are emptied daily. The locations which have permanent hoppers are these:

a. Straight and cut units, two hoppers.
b. Buffer, one hopper.
c. Electric furnace, one hopper.
d. Three Steckel mills, one hopper.
e. Rolling departments, seven hoppers.
f. Inspection departments, eight hoppers.
g. Plating line, seven hoppers.
h. Lacquer line, one hopper.
i. Finishing department, two hoppers.

The ten "miscellaneous" hoppers are moved from one area to another as needed. While they are used most often for metal scrap, they occasionally are utilized for waste paper or other debris. Recently, for example, Thomas Strip replaced part of its wooden block floor. Part of the equipment on the job was a hopper used to haul old bricks to the trash dump. ▲

Figure 1 — Operator obtains sample of the frozen contents of the hearth by core drilling.

Scientists Examine Blast Furnace Operation

SOME interesting data on iron-making may be developed by scientists of United States Steel Corp., who conducted an experiment in which the contents of an experimental blast furnace of the U. S. Bureau of Mines were "frozen" during the iron-making process. The data gives science a rare opportunity to examine the full cycle of the transformation of raw materials to iron as it takes place inside a blast furnace.

To chart the step-by-step reduction of ore to iron, U. S. Steel scientists, in co-operation with the Bureau of Mines and technicians from the Linde Air Products Co., suddenly quenched the contents of the hot operating furnace with a blast of nitrogen. Thus, the blast furnace process was halted in midcycle.

Figure 2 — Cross section of frozen hearth contents shows coke distributed throughout slag and metal.

The loose material in the furnace was removed as 3000 six-inch cube samples during the dismantling of the furnace. The 5200-lb solid mass of coke, metal, and slag remaining in the furnace hearth was sampled by core drilling to remove twenty 3-in. diam "core" samples.

While complete analysis of all the samples will require many more months, a number of interesting observations have been made to date. For example, coke was found throughout the slag and metal layers in the hearth, and preliminary analyses of the samples taken from the furnace revealed that the raw materials that are loaded into the top of the furnace in layers move down to the combustion zone in stratified form. Until they reach the smelting area, they remain relatively unchanged in physical appearance.

As a result of further studies, U. S. Steel scientists hope to trace the ore reduction process through the various zones of a blast furnace. They also hope to determine the mechanism of sulphur transfer and chart the path of the sulphur exchange between the iron, the coke, and the slag.

Among the other iron-making mysteries which they hope to unravel are the size and location of the fusion zone and the chemical changes in raw materials that take place in the fusion zone.

The opportunity to conduct the freezing experiment came last October when the United States Bureau of Mines decided to move its 34-ft tall experimental blast furnace from the Oakland area of Pittsburgh to Bruceton, Pennsylvania. U. S. Steel's research team of blast furnace specialists developed the idea in cooperation with the Bureau of Mines, and the Linde Co. supplied nitrogen for the freezing process. This presented an unusual opportunity because the cost of freezing and dismantling a large furnace is prohibitive.

A total of 3,000,000 cu ft of nitrogen was introduced into the furnace over a two-week period. To aid in the cooling process, cold water was poured over the furnace shell. The nitrogen was pumped in through the furnace tuyeres.

The information obtained in this experiment will be a vital contribution to a better basic understanding of the blast furnace process. ▲

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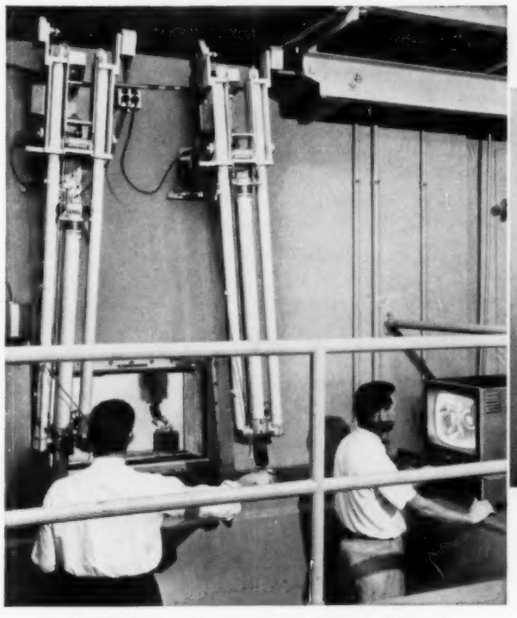

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Diamond "UtiliVue" camera mounted in radioactive cell has remote focus and three-position remote control lens turret.

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This is one of many installations where a Diamond "UtiliVue" permits close watch of operations with complete safety to personnel. The Diamond ITV Camera here is an invaluable ally to the viewing window as the mechanical manipulators handle radioactive material. It provides important depth perception and permits a close-up view for fine detail.

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Latest Advances Are Incorporated In New Seamless Mill at Y.S.&T.'s Indiana Harbor Works

MANY unusual features are incorporated in Youngstown Sheet and Tube Co.'s modern new pipe mill recently put in operation at the Indiana Harbor Works.

One of the outstanding automatic features is the rotary hearth furnace designed to heat 190 solid steel billets an hour to a temperature of 2250 F.

Modern quality control equipment and methods, testing and inspection devices, x-ray machines and automatic centralized lubrication systems also are employed.

The mill, which started operation in September, 1956, produces pipe in sizes varying from 4½ to 9⅝ in. in outside diameters primarily for use by Youngstown's customers in the oil and gas industry.

The equipment to make the pipe is in a two-part building. The "plug" mill section is 2100 ft long and 115 ft wide and the piercing unit is 1920 ft long and 100 ft wide.

In the initial step of the operation, the round steel billets are charged automatically into the rotary hearth furnace. These billets can vary in length from 4½ to 16½ ft and from 4½ to 9 in. in diam. As finished pipe the billet may have maximum length of 50 ft.

After the solid bar has been uniformly heated it is conveyed on table rolls to the first piercing operation where the billet is rotated and horizontally advanced between two oblique rolls.

The first piercer makes the hole in the bar. The pipe shell is then conveyed to a second piercing mill which elongates the shell, reduces the wall thickness and increases the outside diameter. In some cases, determined by wall thickness, one piercer can do this job.

The billet is then moved into a reheat furnace before it is transferred to the "plug" mill.

The wall of the pipe is further reduced to the finished thickness by rolling the hollow bar over a stationary round plug. The pipe is then conveyed to a reeling operation where a smooth inside and outside finish is produced.

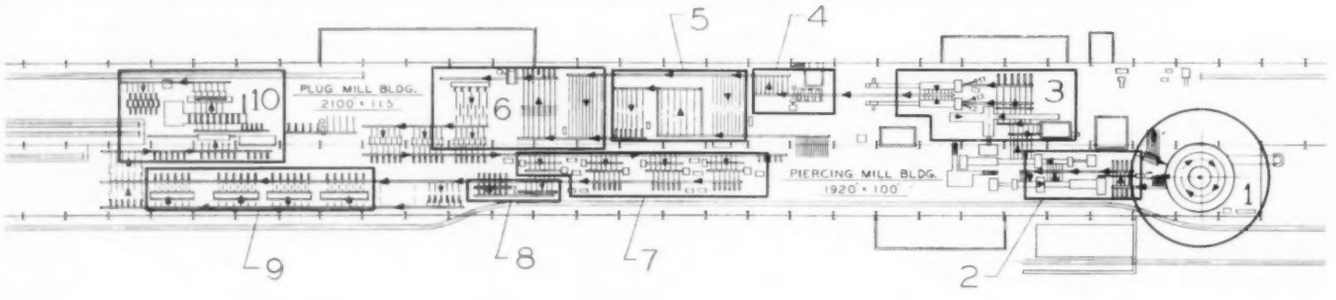
The outside diameter of the pipe coming from the reeling machines is brought to close tolerances by a final sizing operation.

The pipe is then passed to a chain-type cooling bed, heated in a normalizing furnace, if specified, cooled again and conveyed to a rotary straightener. Then the product is carefully inspected for size, wall thickness, concentricity and for inside and outside surface quality.

At the cutoff machines the ends are trimmed and the pipe cut to specified lengths. Pipe requiring threading is transferred to automatic threading machines.

An automatic test completes the inspection. All pipe must be gas, air and oil tight. To insure this, the

Figure 1 — Layout of new seamless tube mill at the Indiana Harbor Works of Youngstown Sheet and Tube Co.



LEGEND

① – ROTARY FURNACE
② – PIERCING MILLS
③ – REHEAT FURNACE
PLUG MILL
REELERS
④ – SIZING MILL
NO. 1 COOLING BED
⑤ – NO. 2 COOLING BED
NORMALIZING FURNACE
NO. 3 COOLING BED
⑥ – NO. 4 COOLING BED
NO. 5 COOLING BED
INSPECTION SKIDS
⑦ – CUT-OFF MACHINES
⑧ – X-RAY INSPECTION
⑨ – THREADING MACHINES
⑩ – PAINTING
WEIGHING
MEASURING
STENCILING
TESTING

Mechanized Cutting Speeds Scrapping of 95-Ton Pressure Vessels

Scrapping huge pressure vessels loomed as a costly, time-consuming job for a large scrapyard in Birmingham, Alabama. But mechanized oxygen-cutting quickly cut this job down to size—and with substantial savings in labor and materials.

The versatile OXWELD CM-45 Portable Cutting Machine teamed up with a C-56 Blowpipe to slice through 8-in. thick laminated steel walls at a speed of 4 to 5 in. per minute. Two 24-ft. cuts were made in each vessel in less than two hours' time. Transverse cuts were then made to reduce these sections to charging-box size.

Today scrapyards, fabricators, and maintenance shops everywhere are slashing costs with the speed and efficiency of mechanized oxygen-cutting.

See how you, too, can save. Ask your nearby LINDE representative to show you the *complete* line of dependable OXWELD Portable Cutting Machines—or write for free catalog F-4487. Do it today!

LINDE COMPANY

DIVISION OF UNION CARBIDE CORPORATION

30 East 42nd Street, New York 17, N.Y.

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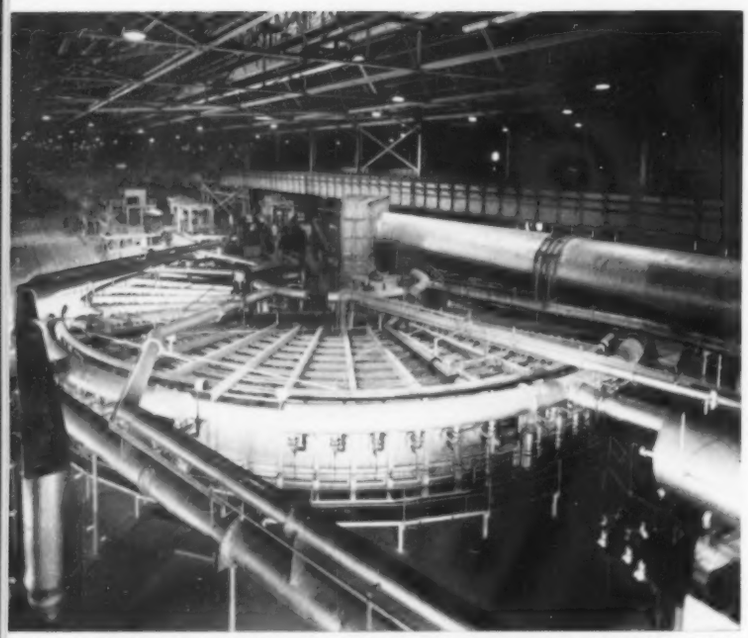


Figure 2 — This rotary furnace is designed to heat 190 steel billets per hr. It has six heating zones and burns coke oven gas or oil.

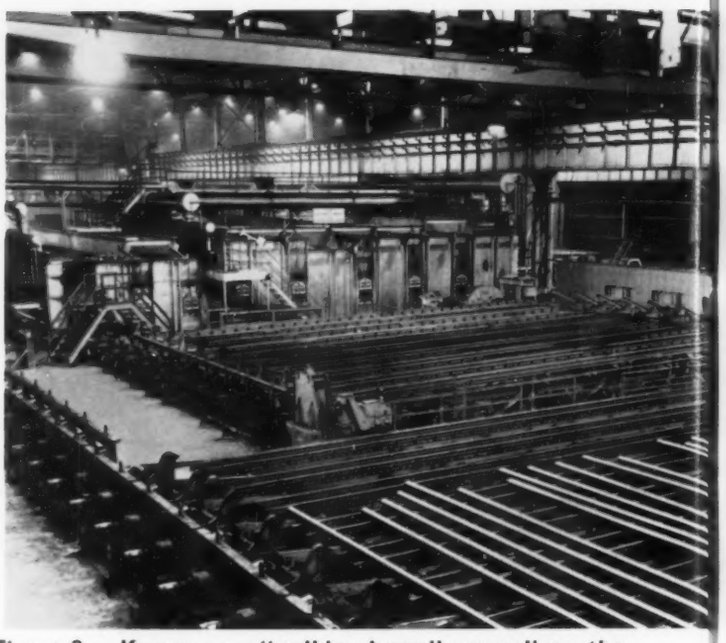


Figure 3 — Known as a "walking beam" normalizer, the furnace covers an area 54 by 66 ft and can handle 190 pieces per hr. It is fired by coke oven gas.

pipe is subjected to a hydrostatic test producing an inside pressure of up to 13,000 psi depending upon the size, wall thickness and grade.

Before testing and shipping, couplings are screwed to the threaded ends. Then the pipe and couplings are stenciled with identifying marks and coated with a rust resistant material. Facilities are built into the mill for shipment of finished pipe by rail and truck.

This is the company's first seamless installation for its Chicago District. Until this mill was put into operation all the company's seamless products were made at Youngstown, Ohio.

Construction was started in 1955. The pipe mill is built in an area that once was part of Lake Michigan. To convert this into land required 2,250,000 cu yd of selected fill hauled in by trucks and dumped over a period of many months preceding the start of construction in 1955.

The buildings and machinery rest on foundations supported by steel pilings driven more than 100 ft down to bedrock.

The concrete poured for footings, floors and machinery bases totals 47,000 cu yd. More than 11,500 tons of steel were used in construction. Of this 9000 tons were used for structural beams and supports; 1880 for reinforcing steel and 620 tons for sheeting.

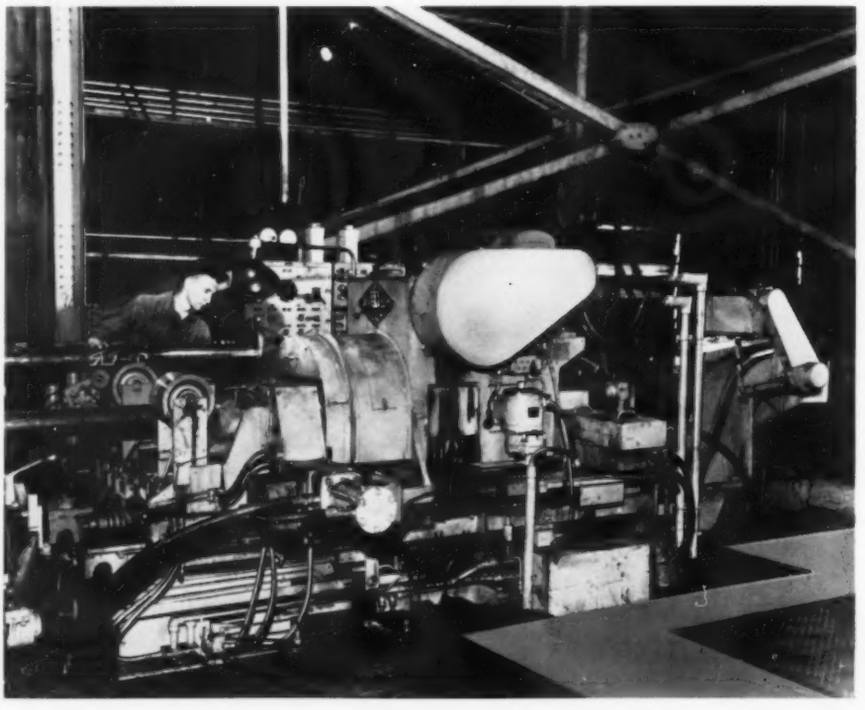
The mill is powered by 1225 electrical motors varying in horsepower from $\frac{1}{10}$ to 4000. There are 845 individual table conveyor motors to drive the rolls that transport the pipe from one operation to another. Some 400 miles of wiring is encased in 100 miles of conduit. Electrical power used by the mill in a month is approximately 1,750,000 kwhr.

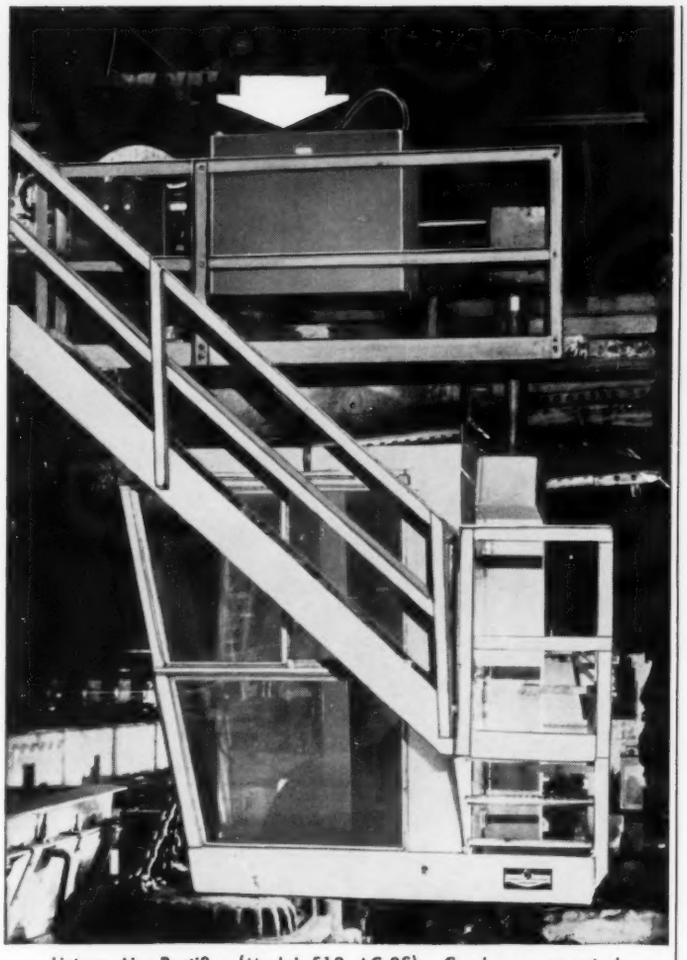
Details on the mill are tabulated in the following appendix:

APPENDIX

MATERIAL CAPACITY	
Minimum outside diam of pipe, in	4½
Maximum outside diam of pipe, in	9⅝
Minimum billet diam, in	4⅜
Maximum billet diam, in	9
Maximum billet weight, lb	3000
Minimum length of billet, ft-in	4-8

Figure 4 — After rough ends are removed, pipe is threaded on both ends on automatic threading machines. Some pipe made at this mill is sold with plain ends for joint welding.





Lintern Aire-Rectifier (Model 513 AC-3S). Condenser, mounted on footwalk, is connected with cooling unit in cab by refrigerant lines of high pressure hydraulic hose.

What Happened at THE TIMKEN COMPANY Since Installation of AIRE-RECTIFIERS

Several years ago The Timken Roller Bearing Co., of Canton, Ohio, installed its first Aire-Rectifier to air condition one of the crane cabs in its steel mill. The company now has several cranes, Lintern-equipped.

In the air conditioned cab, an operator works an uninterrupted 8-hour trick in complete comfort — even over soaking pits.

Air conditioning of crane cabs, according to The Timken Roller Bearing Co., has resulted in more efficient utilization of manpower, greatly improved working conditions, and safer crane operation.

Such is the experience of hundreds of companies using Lintern Aire-Rectifiers. May we discuss your situation with you? Ask for Bulletin AC 573.

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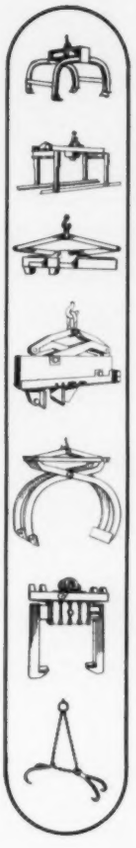
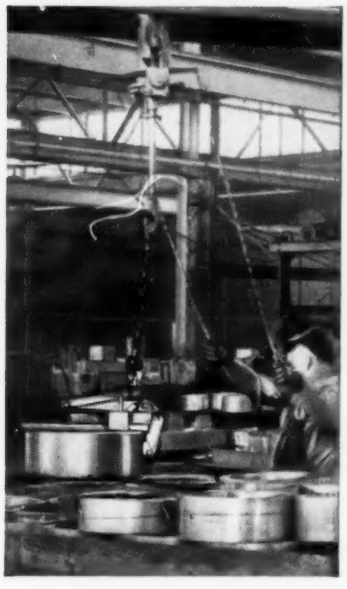
No. 4

Facts About: MANSAVER® GRABS



LOW HEADROOM STYLE 1145



Under the jib crane shown in a low storage bay, the Mansaver style 1145 permits highest possible storage. The low headroom feature is obtained by resetting the grab for a limited portion of a complete range. The range of rim thicknesses it can handle is equal to that of other designs.

The grab is fully automatic, picking up or releasing the load from a remote point if essential.

Variations of the same basic design permit handling two coils at once, very narrow coils and light gauge materials. A simplification of the design is supplied when price is important.

Write for names and addresses of neighboring plants where you can see Mansaver Grabs in operation.

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3116 EAST ST., NEW HAVEN 11, CONN.
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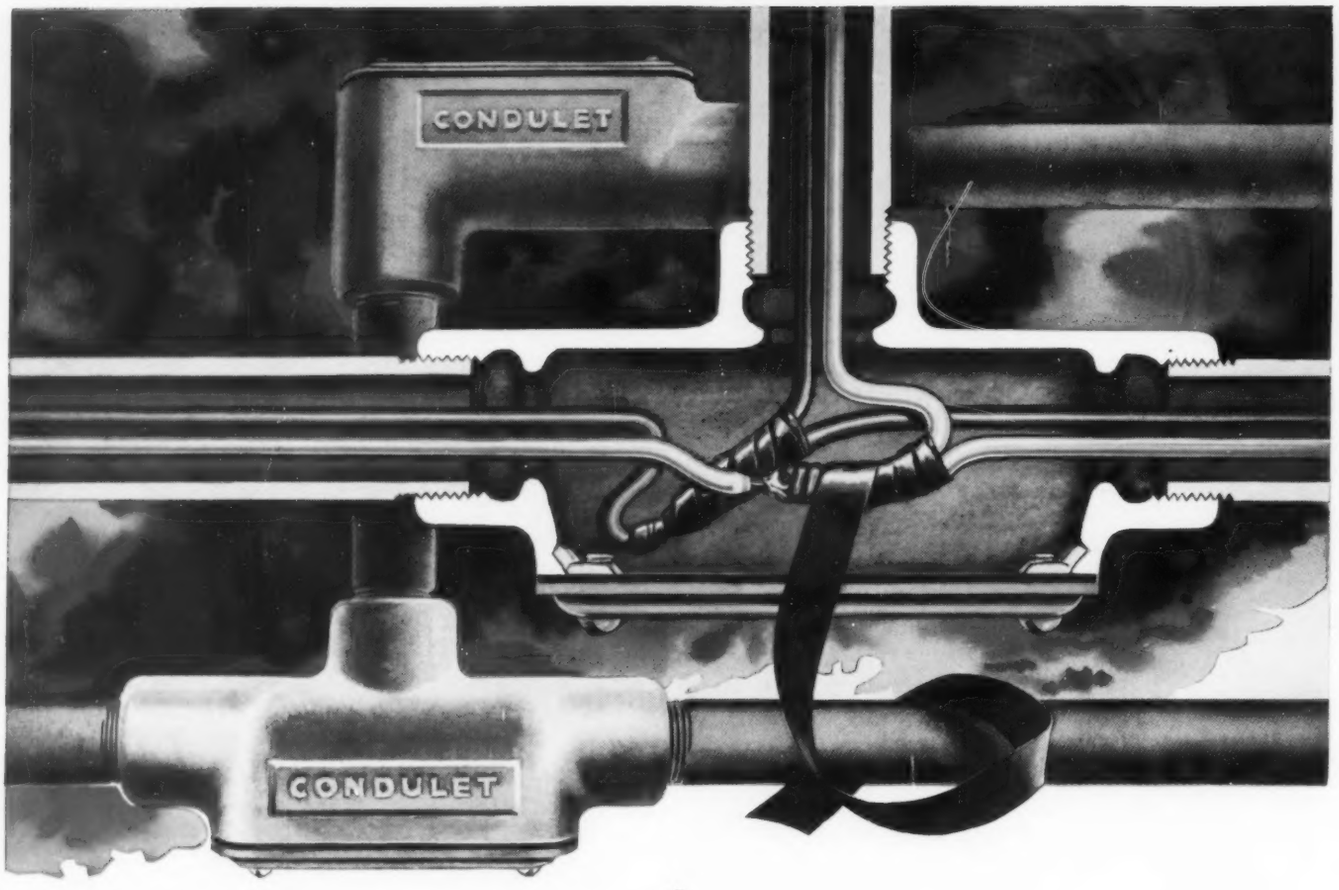
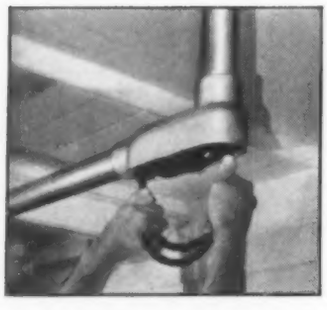
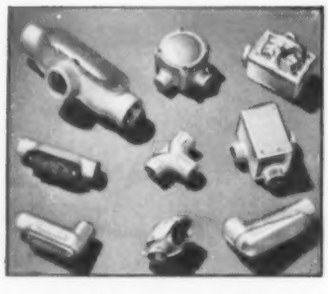




Condulets install easily. There's room inside to do a good wiring job. No sharp edges to scrape knuckles or cut into insulation. Once installed, wiring, Condulet and conduit are there to stay—yet wiring remains easily accessible for future alterations.



Used everywhere. There is a Condulet for every need, in every conceivable industry. Each one bears the marks of superior construction. Each is made by craftsmen to the standards craftsmen demand!

Why electrical engineers specify

"CONDULETS . . . OR APPROVED EQUAL"

Electrical engineers are called upon daily to make careful choices of materials for companies who depend upon their judgment for the quality of finished work.

"Condulets or approved equal" is the common notation on specification prints everywhere. It is used to indicate *the standard of performance* demanded by the electrical engineer.

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

More than 15,000 items of Condulet electrical equipment offer a broad choice of explosion-proof, dust-tight or conventional construction unparalleled for safety and dependability. In *any* plant, the chances are 2 to 1 you will find Condulet junctions, switches, conduit fittings, plugs and receptacles, panelboards, pushbutton stations, motor control centers, etc. Wherever you see the name Condulet, you see the standard by which maximum performance is measured.

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Maximum length of billet, ft-in.....16-6
Maximum length of hot pipe, ft.....51
Maximum length of finished pipe, ft.....50
Grades and type of pipe.....Oil country tubular goods, line pipe and merchant pipe within size limitations shown above.

Rotary Hearth Furnace
Size.....85 ft-5½ in., outside diameter.
Type.....6 zones billet heating.
Fuel.....Coke oven gas and/or oil.
Billet length....16½ ft, maximum.
Pieces per hour..190
Tons per hour..100

No. 1 Piercing Mills
Roll diam.....36 in., minimum; 40 in., maximum.
Billet size, entering.....4⅜ to 9 in., outside diameter.
Pipe size, leaving.....9⅞ in., outside diameter, maximum; 27 ft maximum length.
Main drive.....4000 hp, synchronous motor.

No. 2 Piercing Mill
Roll diam.....36 in., minimum; 45 in., maximum.
Billet size, entering.....4 ft-8 in. to 16 ft-6 in. (Same as Number 1 for single piercing.)
Pipe size, leaving.....11¾16 in., maximum, outside diameter. 38 ft maximum length.
Main drive.....4000 hp, synchronous motor.

Reheat Furnace
Size.....43 by 17 ft-4 in., inside chamber.
Type.....Roll down.
Fuel.....Coke oven gas.
Capacity.....190 pieces per hour.

Plug Mill
Main drive.....2000 hp synchronous motor.
Stripper drive...150 hp.
Pipe length.....51 ft, maximum.

Reelers (2)
Main drive.....Two 400 hp, wound-rotor motors each.

Sizing Mill
Type.....7 stands.
Main drive.....700 hp.

No. 1 cooling bed
Type.....Roller chain drive.
Drive.....25 hp, maximum.

Normalizing Furnace
Type.....Walking beam normalizer.
Size.....54 by 66 ft.
Capacity.....190 pieces per hour.
Fuel.....Coke oven gas.

No. 2 Cooling Bed
Type.....Roller chain drive.
Drive.....25 hp, maximum.

No. 3 Cooling Bed
Type.....Roller chain drive.
Drive.....25 hp, maximum.

No. 4 Cooling Bed
Type.....Roller chain drive.
Drive.....25 hp, maximum

No. 5 Cooling Bed (equipped with water sprays)
Type.....Roller chain drive.
Drive.....25 hp, maximum.

Straightener
Type.....7 roll.

Cut-off Machines
Type.....4 pair.
Capacity.....4½ to 10¾ in., outside diam.

X-ray Inspection
Type.....1 pair.
Capacity.....Maximum wall thickness, ¾ in.

Threading Machines
Type.....4 pair machine threaders.
Capacity.....4½ to 9⅝ in., outside diam.

Testing
Type.....1 hydrostatic testing bench.
Capacity.....4½ to 10¾ in., outside diam.
Maximum testing pressure...13,000 psi.

Pipe Coating
Type.....Pressure spray nozzle.

Coupling Machine
Type.....Single unit.
Capacity.....4½ to 9⅝ in. outside diam pipe with couplings attached.▲

Open Coil Anneal System Designed for Steel Plant Operation

THE Lee Wilson opened coil recuperative annealing system sets new standards in heating speeds and temperature uniformity. Comparative cost analyses reveal that the system will make important reductions in annealing costs.

Complete flexibility is achieved with batch-type handling and high heater capacity, permitting individual coil temperature control of varying coil weights. Depending on the size of the coil, the system will produce about 20 tons of uniformly annealed product per hour.

HEATING PRINCIPLE

The heart of the system is in the methods used to expand tight coils, index them through successive furnace stations, and rewind them into final tight form. As a hard, tightly-rolled coil comes from the cold reducing mill, it is rewound into open, expanded form with the space between laminations 50 to 300 per cent of the steel gage. Thus, atmosphere gases circulate freely through the open laminations during annealing. The rate of heating is determined by the amount of surface area and the difference in temperature between the work and the atmosphere gases. Strip gage and coil diameter are negligible factors in so far as heating rate is concerned.

The surface area of an opened coil presents 200 to 1000 times the area for heat transfer compared with a tight coil. Volume of atmosphere gas normally circulated is 15 or more times the volume circulated per coil in the standard bell-type furnace using convector plates. Although the opened coil method can be used with the bell furnace in single or multiple stacked arrangements, the bell furnace does not approach the recuperative system for heating speed and handling efficiency.

OPERATING SEQUENCE

A tight coil coming from the cold mill is moved to the tight coiling table. The mandrel is extended

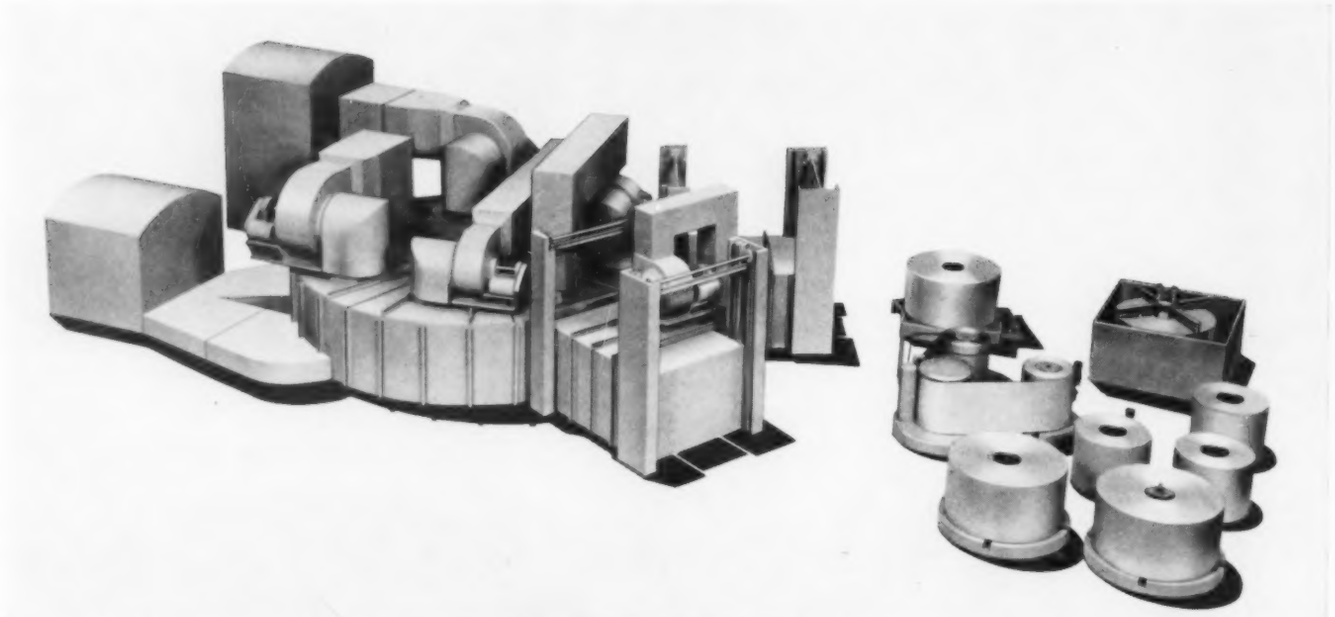
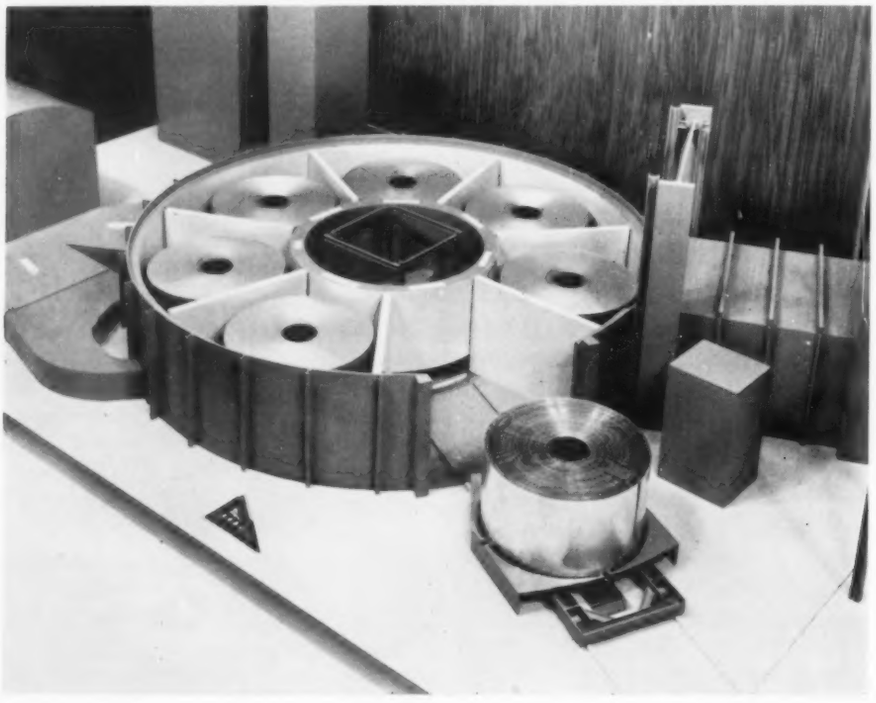


Figure 1 — Initial tests indicate open coil recuperative annealing system will establish new standards in heating speeds, temperature uniformity and opened coil handling. The system is based on two operations; the first, opening the coils to permit hot gases to circulate completely through the coil, and the second, a unique hot gas recuperative arrangement that salvages the hot gases from the cooling coils, directing them to preheat coils just entering the annealing process.

through the table and the coil fed around the tension roll and attached to the winding block on the expanded coil table. A string is inserted at the top edge of the coil and the coil is wound to the desired expanded diameter. After the coil is completely expanded and an overhead boom has removed the string, the coil is lifted with a special coil handler, engaging the bottom of the coil through slots in the turntable. The coil then can be moved directly to the furnace or moved to a cleaning area where any remaining oil from the cold mill is removed by dip-cleaning or by exhaust gases from the heaters. The clean coil is placed on a special platform straddling the coil handling car, and driven into the purge chamber.

First heating stage—After inert atmosphere gas or standard annealing atmosphere has purged the chamber, the coil-carrying car positions the coil and platform on the hearth. The car returns to the purge chamber and the heating cycle is started.

Figure 2 — The top has been removed from the model furnace to show how the coils of steel are indexed around the rotary hearth in "lazy Susan" manner.

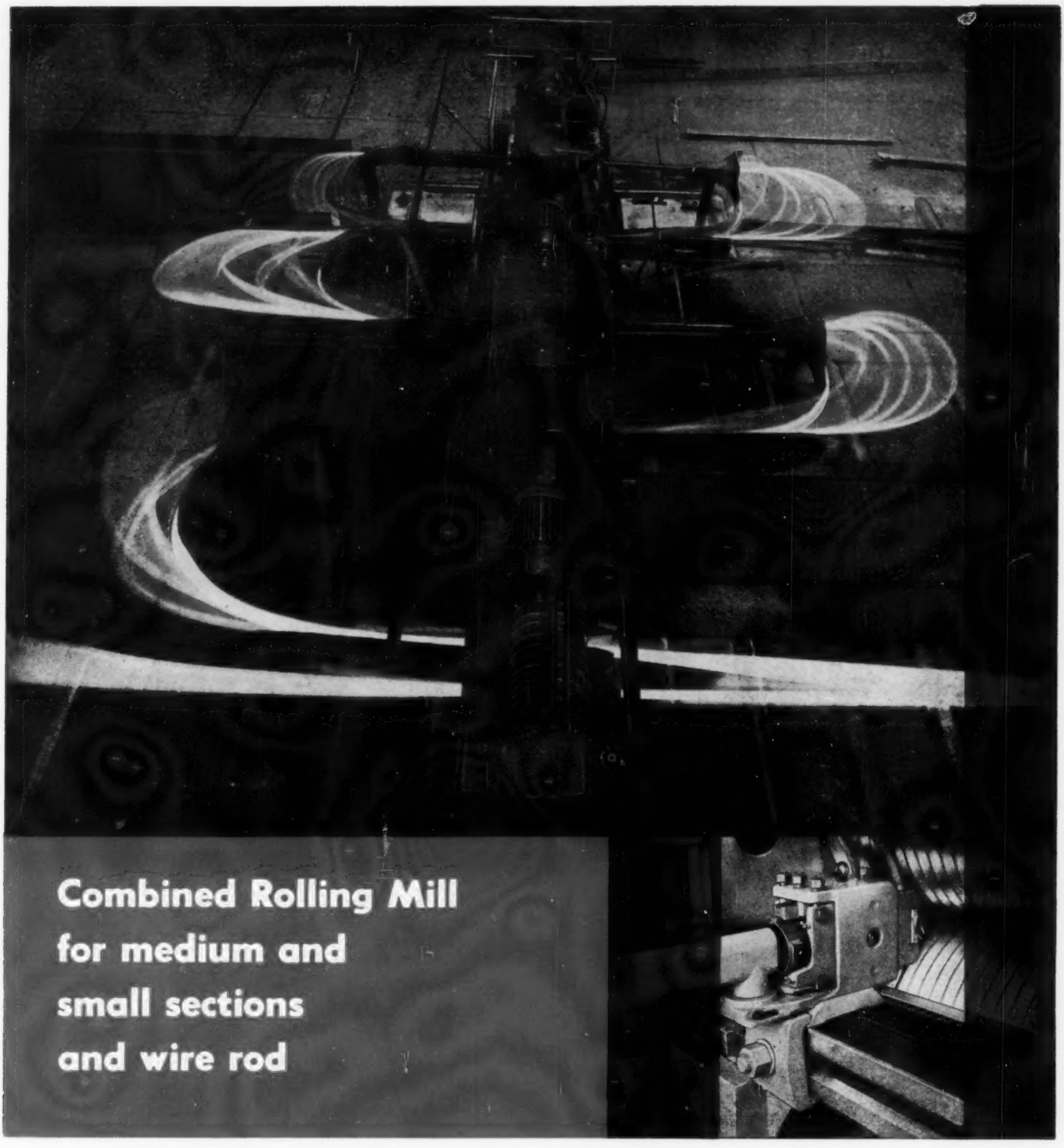


The coil is heated by a recuperative system which transfers heat from coils being cooled to coils being heated. Atmosphere gas picks up heat as it is pulled by a blower down through the cooling coil and delivered into a connecting duct. The hot gases are drawn from the connecting duct through the cooler coil, transmitting heat to this coil while passing through the strip laminations. For most coils, temperature equalizes at 450 F within approximately 30 minutes, even though initial coil temperatures are 900 F or more apart.

Second heating stage—Next, the coil is heated from approximately 450 to 900 F by a second recuperative cycle. A blower located over a coil in the first cooling zone pulls gases up through it and directs the hot gases down through the coil being heated. As in the first stage, temperature equalizes within approximately 30 min. At the end of one hour, the coil is moved to the first heating station.

First heating station—Atmosphere gas is circulated through a radiant tube heater with an output of approximately 7,000,000 Btu's per

(*Please turn to page 156*)



Combined Rolling Mill for medium and small sections and wire rod

Roller guide No. 60

Rolling with repeaters in a 19,3—21,6 in. 3-high train of MORGÅRDSHAMMARS combined medium section, small section and wire rod mill.

Our production schedule includes complete mechanical equipment for the combined rolling mill.

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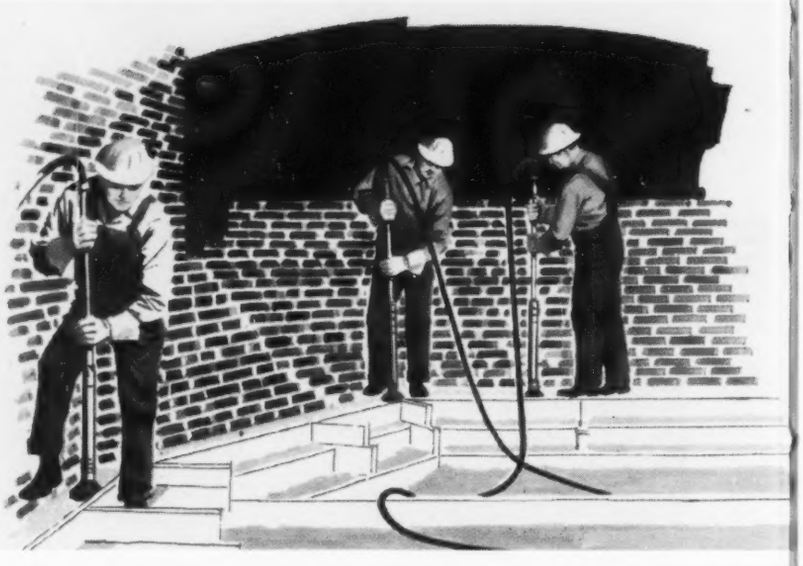

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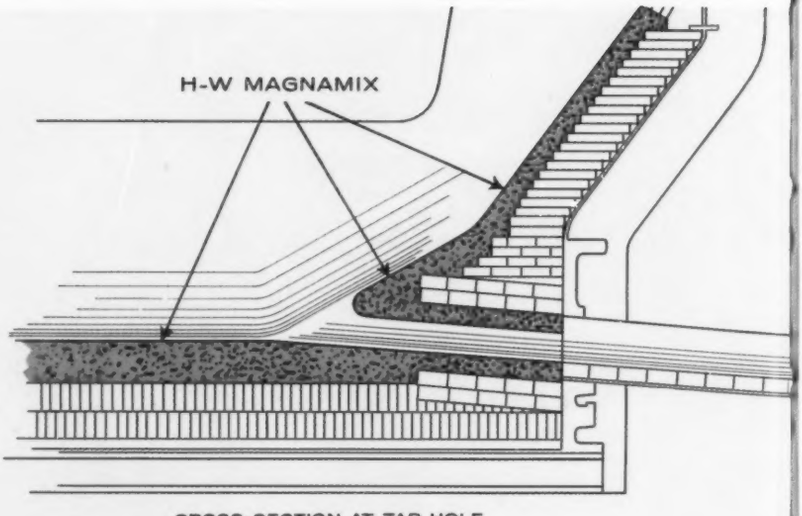
H-W MAGNAMIX



CROSS-SECTION AT TAP HOLE

RAMMING MIXTURES

basic hearths

H-W C-MIX (high purity seawater periclase) used for contour-rammed open hearth and electric furnace bottoms greatly reduces furnace downtime, saves labor and avoids burning-in sacrifice of refractory superstructure. And with its measurable margin of superior properties, costs are decidedly lower and furnace availability is greatly increased.

• **High Magnesia Content**—Made from high purity seawater periclase with the magnesia content over 92%, H-W C-MIX best withstands the corrosive action of highly basic slags.

• **Stable**—It is fully converted to periclase and has excellent volume stability with negligible shrinkage at highest operating temperatures.

• **Hydration Resistant**—H-W C-MIX is unique in its high degree of resistance to hydration.

• **Strong**—High strength over the entire range of steel furnace temperatures accounts for its unusual resistance to erosion.

• **Dense**—High density and low permeability retard penetration by molten metal and corrosive slags.

• **Economical**—H-W C-MIX provides the most durable monolithic hearths with low installation cost.

H-W MAGNAMIX of 80% magnesia content stabilized as periclase, is made from dead-burned Washington magnesite. It is particle sized to secure maximum density. While H-W MAGNAMIX is dependable for making new bottoms, it is especially adapted for bank maintenance, patching deep holes and repiping tapholes. It sinters into a hard dense monolith in a very short time at approximately 1000°F. lower than operating temperatures.

• **High Magnesia Content**—It is used without the addition of slag or scale, thus avoiding dilution of its high magnesia content.

• **Dense**—As rammed into place, it becomes exceedingly dense and impermeable. When heated to operating temperatures, its density is further increased and a homogeneous monolith is formed.

• **Strong**—H-W MAGNAMIX has a strong cold set with the unusually high crushing strength of 1500 psi.

• **Durable**—Its excellent resistance to erosion accounts for its splendid records and wide adoption in taphole service.

• **Easy To Use**—It has superior properties for patching large holes in banks and bottoms, and is applied by air-ramming, gun placement or by hand in hot patching.

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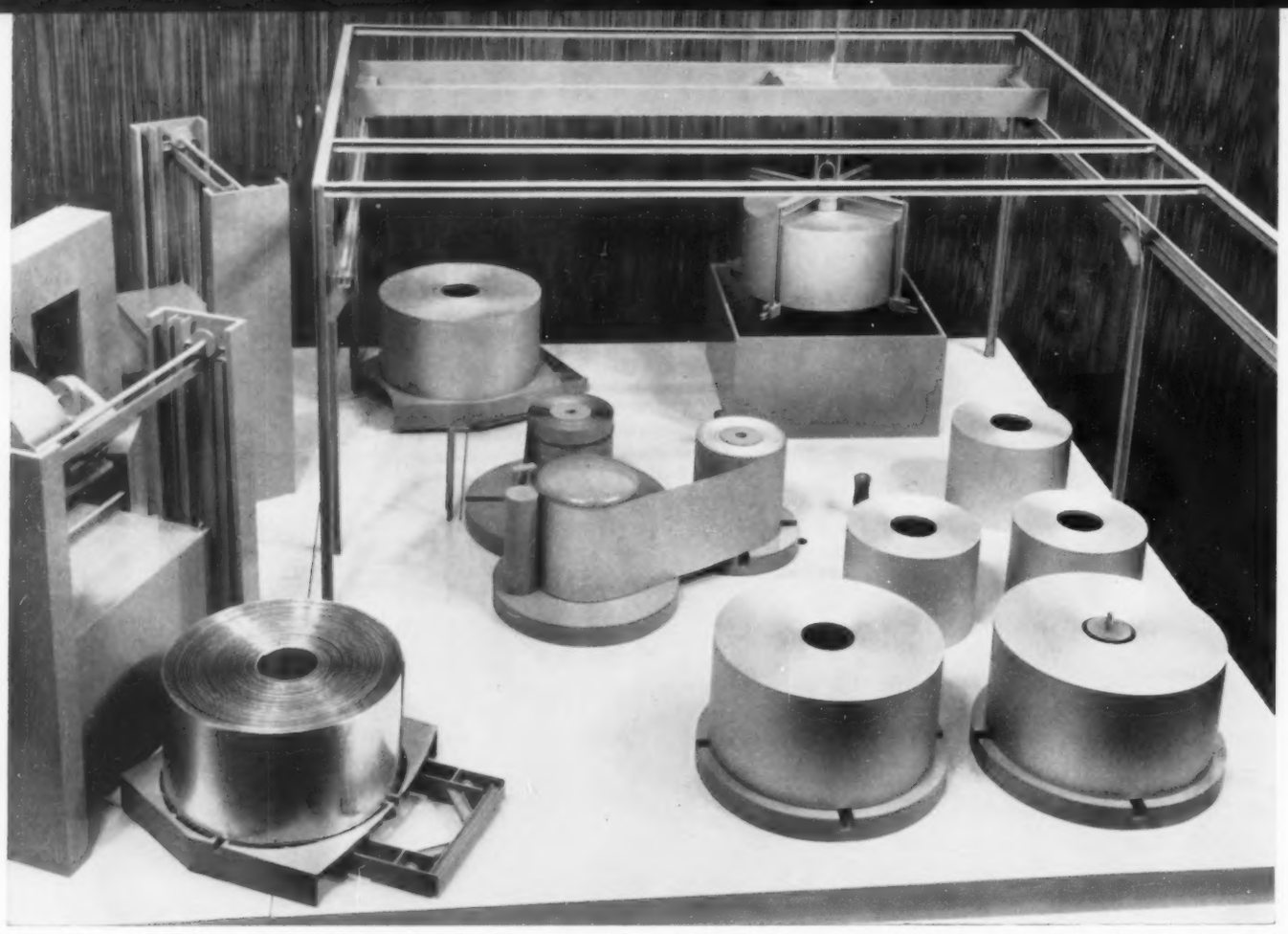


Figure 3 — Model arrangement shows a typical coil handling station to be used with the new system. Note "loose" or opened coil in foreground just leaving cooling chamber of furnace. Coil "opening" machine is in process of rewinding tight coil into an open coil prior to annealing. Note here, too, the use of light crane equipment.

(*Continued from page 152*)

hr. The gas is directed through the coil laminations, rapidly heating the coil to approximately 1300 F. The coil is then indexed to the next heating station.

Second heating station—Positioned in this station, the coil receives heated gas direct from the coil in soak ahead of it, bringing the coil to a uniform annealing temperature. A smaller heater section maintains the coil ahead at soak temperature. By this process, the bottom edge of the coil is brought to full annealing temperature in the first heating station and then, by reverse flow, the top edge and remainder of the coil are brought to full annealing temperature in the second station. The result is a full hour's soak at uniform annealing temperature in the third station.

First and second cooling stages—As outlined before, heat transfers from the coil in the first cooling stage to the second heating stage. The cooling coil is dropped from annealing temperature to approximately 950 F in this station. The coil is then moved to the second cooling stage, and regenerates heat for the first coil in the heating process. The cooling coil drops in temperature from approximately 950 to 500 F and is then moved into a cooling chamber operating on the same atmosphere gas as the rotary hearth. Gas is circulated with a 20,000-cfm blower through a 2,000,000-Btu water-tube type cooler. Here the coil cools from approximately 500 to 250 F and is then moved to the coil unloading station. The coil is then removed from its platform and placed over a cooling grid where air, drawn down through the open laminations, cools the coil to room temperature prior to recoiling. In the meantime, the platform is moved from the coil unloading station to loading position and the car moved into the cooling chamber, ready to remove the next coil from the hearth.

Rewinding the expanded coil—Now at room temperature, the coil is moved to the expanded coil table. The strip is fed over the tension roll and attached to the block on the tight coiling table. Wound into tight form, the coil is taken from the annealing department, usually on a roller conveyor.

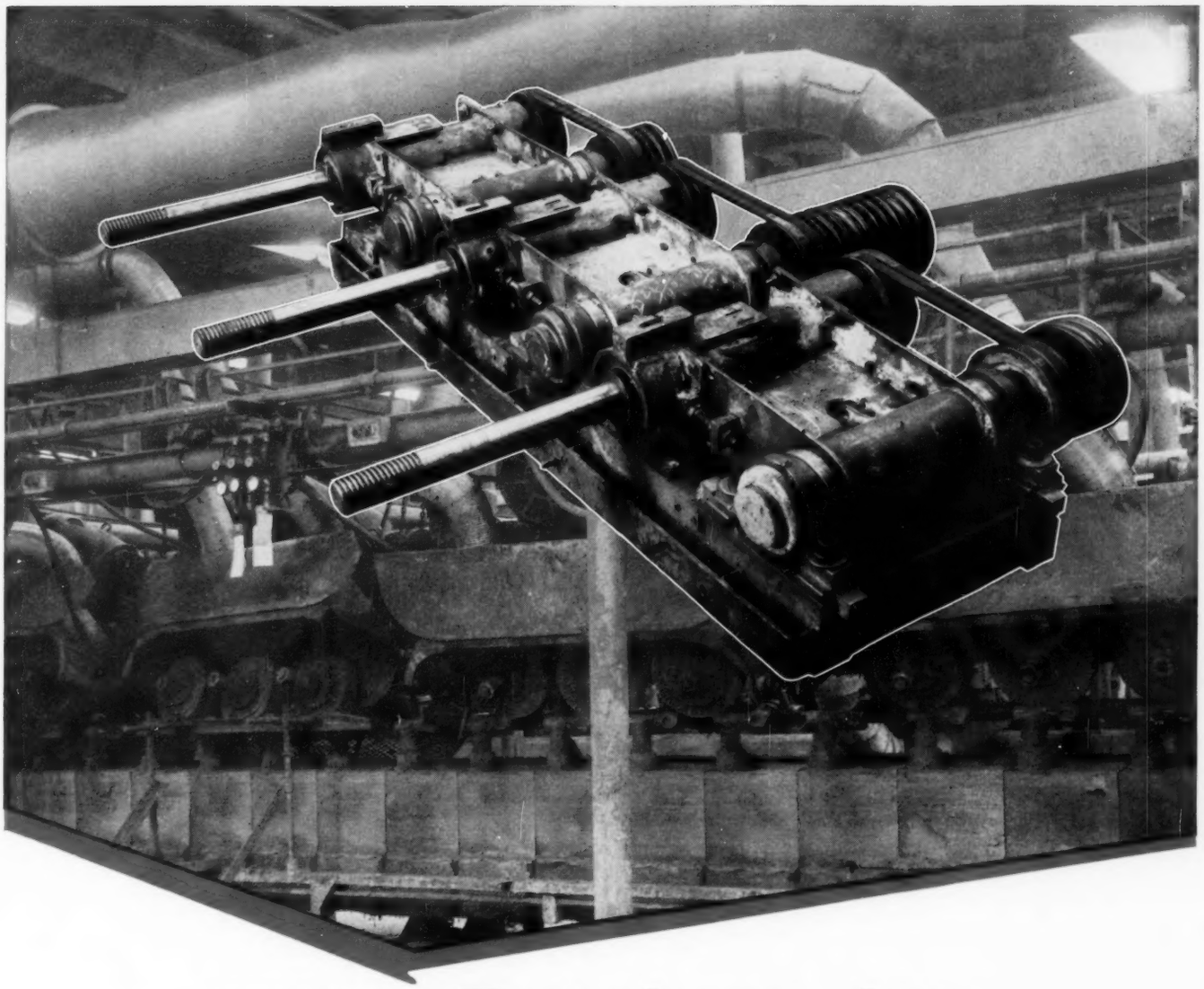
SUMMARY

By circulating 20,000 cfm in the regenerative and cooling cycles, 40,000 cfm in the heating zones, a high uniformity of temperature and metallurgical results are attained. In addition, the station-to-station counterflow system brings the coil to a much quicker equilibrium and more uniform condition.

Station-to-station time intervals may be shortened or temperatures raised or lowered to suit a predetermined annealing cycle. With tinplate, the soak zone can be eliminated and the number of coil stations for heating and cooling varied.

Table I covers cost analyses for comparative operation with other furnace equipment. Table II covers advantages of opened coil annealing, and the coiler operation.

(*Tables are on page 158*)



Here's a Bearings, Inc. idea that saved our customer $3,000 in labor, maintenance and parts in 7 months

Only an authorized bearing distributor such as Bearings, Inc., with the experience and facilities we have at our disposal, could have designed and supplied the special housings that hold the flinger sealed bearings that now have effectively solved this difficult bearing maintenance problem.

A well known automotive stamping plant designed and built this tandem buffing head (shown above) for its own use. Due to the extremely high concentration of metal dust from the buffing and polishing wheels conventional bearings had a very short life. Over 300 bearings were purchased in 7 months. Downtime due to bearing failure was very costly. The actual labor and material cost of replacing the bearings during this period exceeded $3,000! Since the new bearing units designed by Bearings, Inc. (shown enlarged) were installed, no bearing failures have occurred and no replacements have been installed.

Remember Bearings, Inc. when you need replacement bearings — Get "factory fresh" bearings of latest design and manufacture. We are *authorized* to sell most famous makes of bearings. We sell *only* those we are authorized to distribute. Call the Bearings, Inc. branch nearest you!

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OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Toledo • Youngstown • Zanesville
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TABLE I
Comparison of Annealing Furnace Equipment
(for 20 tons per hour, 14,000 tons per month, 168,000 tons per year)

Equipment	Opened coil system	Cover type, 4 stand
Furnaces	1	5
Coilers and control	1	0
Bases	0	15
Auxiliary equipment		
Platform (charging supports)	10	60
Inner covers	0	60
Convectors	0	240
Cover plates	0	60
Crane	One 25-ton	One 60-ton
Building	5500 sq ft	21,000 sq ft
Building for coil cooling	0	2,000 sq ft
First Cost Comparison		
Furnace equipment	$900,000	$ 750,000
Auxiliary equipment		
Inner covers (alloy)	0	271,500
Convectors and cover plates	0	56,700
	$900,000	$1,078,200
Operating Costs Per Ton		
Labor@ $3.00 per hr	$0.30 at 10 ton per man-hr	$0.38 at 8 ton per man-hr
Fuel@ $0.50 per million Btu	0.30 at 600,000 Btu per ton	0.50 at 1,000,000 Btu per ton
Electrical@ $0.01 per Kwhr	0.07	0.15
Atmosphere gas @ $0.08 1000 cu ft	0.04	0.09
Miscellaneous utilities and equipment	0.10	0.10
	$0.81	$1.22
Maintenance Costs, $ Per Ton		
Furnace and base repairs	$0.10	$0.20
Inner cover—6-year repair and replacement	0.00	0.30
Convector—2 years	0.00	0.16
Tubes	0.04	0.06
Crane	0.03	0.10
	$0.17	$0.82

Equipment	Opened coil system	Cover type, 4 stand
Interest and Depreciation		
Depreciation—10 years	$0.68	$1.50
Interest—6 per cent	0.22	0.67
	$0.90	$2.17
Cranes, Building and Installation Costs		
Buildings		
For equipment@ $15 per ft	$ 82,500	$ 315,000
For coil cooling	0	24,000
Foundations	70,000	500,000
Installation	50,000	160,000
Crane	50,000	430,000
	$252,500	$1,429,000
Steel Inventory		
In process@ $120 per ton	$38,400	$432,000
Cooling for temper mill	9,600	172,800
	$48,000	$604,800
Total Capital Costs		
Furnaces	$ 900,000	$1,078,200
Buildings, cranes and installation	252,500	1,429,000
Steel inventory in process	48,000	604,800
	$1,200,500	$3,112,000
Capital savings	$1,911,500	
Summary of Costs		
Costs per ton	Costs per ton	Costs per ton
Operating	$0.81	$1.22
Maintenance	0.17	0.82
Interest and depreciation	0.90	2.17
Total annealing costs	$1.88	$4.21
Saving	$2.33 per ton	

TABLE II
Advantages of Opened Coil Annealing

1. Lower First Cost
   a. Requires less building space for equivalent tonnage.
   b. Less foundation work required.
   c. Lighter building construction and also floor thickness.
   d. Light weight crane, floor operated, replaces normal mill type crane.
   e. Coil cooling space eliminated, as cooling can be included in furnace operating space.
   f. Less atmosphere gas required.
2. Lower Operating Costs
   a. Fuel costs are lower because of the recuperative heating from cooling coils.
   b. Less labor is required in two man operation from entire furnace area and coil equipment. All moves are within limited space and handling of equipment is accomplished with a single lifter.
   c. Electrical power is less than for standard furnace equipment.
   d. Crane moves are eliminated as these can be handled by furnace operator, except for incoming coils and coils to the temper mill.
   e. Other utilities are minimum.
   f. Maintenance is less as fewer mechanical units are involved, shorter cycles at elevated temperature and much lower unit loading on the charge support and support base structure.
   g. No inner covers are used or convectors or top cover plates which deteriorate with time and temperature.
3. Better Product and More Uniform Quality
   a. Uniform heating can be accomplished throughout the coil.
   b. Better surface condition can be obtained with cleaning of coils prior to annealing and full exposure of surface to atmosphere gas.
   c. Eliminates sticking as the coil is loose and does not have the concentrated edge load. A loose coil permits free expansion and contraction between the strip and the supporting steel and the loading factor is decreased because of the space between coil laminations.
   d. Controlled temperature and soak can be accurately determined and will be uniform for all parts of the coil.
4. Simpler Control and Operation
   a. A simple line flow of coils into and out of the department simplifies handling and keeping of coil records.
   b. Two zone temperature control with automatic recording of coil number simplifies instrumentation and coil temperature records.
   c. Temperatures can be recorded by radiamatic temperature control of coil edge rather than normal type thermocouples.
   d. Individual coil temperature and soak can still be maintained with this type of furnace.
   e. Punch card system can easily be utilized for line flow of coils.
5. Faster Processing
   a. Coils can be annealed and cooled within one day as compared to six or seven days in the standard type furnaces.
   b. Minimum overhead should result from the fast processing of coils and the simplified data keeping.
6. Lower Inventory
   a. Coils in process will be very low, less than 0.1 single stack and less than 0.07 for four stack furnaces.
   b. Coil cooling is eliminated other than at the furnace cooling area. For standard furnaces the full production in tons per hour must cool for several days prior to temper rolling.
   c. The reduction of steel coils in inventory reduces not only floor space, handling time, coil record keeping, etc.; in addition the working capital available is greatly increased for more production and improved equipment. ▲

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bar, hoop, strip, shape mill guides; and rollers.

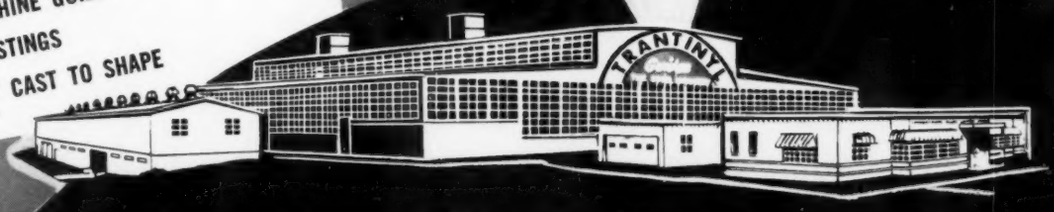
SEAMLESS TUBE MILLS:
guide shoes, rolling mill plugs and rolls, piercer points, etc.

ELECTRIC WELD TUBE MILL:
forming rolls, planishing rolls, tool holders, etc.

STRAIGHTENING MACHINE GUIDES

HEAT RESISTING CASTINGS

"TRANTINYL No. 1" CAST TO SHAPE



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Youngstown, Ohio

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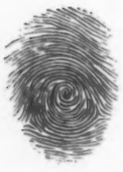
- *Second*–Galvinoleum provides lasting protection for older galvanized surfaces, too. Just be sure that all former coatings are removed before applying Galvinoleum.
- *Third*– You can beautify as you protect in your choice of four attractive Galvinoleum colors–Red, Gray, Green, Metallic.

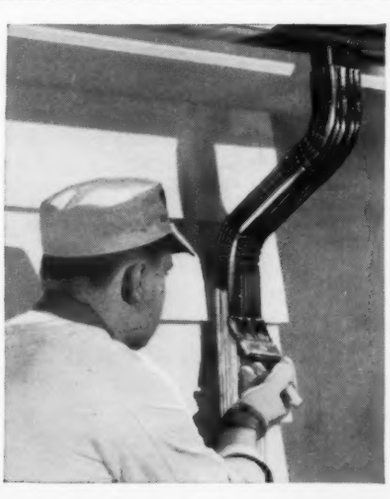
Look around! How many galvanized metal surfaces do you have–gutters, downspouts, roofs, siding, heating and air conditioning ducts, etc.? Galvinoleum used now can prevent peeling "headaches" later. Make it a point to check with your Rust-Oleum Industrial Distributor for a free test demonstration or application. He'll be happy to consult with you on your galvanized metal maintenance problems. Attach the coupon to your letterhead for a free test sample and name of your nearest Rust-Oleum Industrial Distributor–there is no obligation.

RUST-OLEUM®



Distinctive as your own fingerprint.
Accept no substitute.

STOPS RUST!®



ATTACH TO YOUR LETTERHEAD FOR FREE TEST SAMPLE OF GALVINOLEUM®

Rust-Oleum Corporation
2655 Oakton St. • Evanston, Illinois

Please send me complete literature and a free test sample of Galvinoleum in the color indicated:

- ☐ Red
- ☐ Gray
- ☐ Green
- ☐ Metallic

Before you buy babbitted and bronze bearings . . . this 6-spot check can help you

pre-judge quality

HOUSINGS are of durable cast gray iron . . . compact, exceptionally strong and rigid. No excess weight.

BASES are finished for close tolerance from base to center of bore—assure firm seating on supports.

BORES are finish-machined to close tolerances . . . assure concentricity, accurate fit on the shaft.

ENDS are finished to provide accurate bearing surface for collar or sprocket . . . reduce friction.

BOLT HOLES in base are slotted to permit easy adjustments for accurate shaft alignment.

LUBRICATION of bearing is provided through grooves and fitting in cap.

You'll find these LINK-BELT features in 15 types and more than 300 standard sizes

Look for these features when you buy babbitted and bronze bearing blocks . . . and you can be sure of long-lasting, free-rolling efficiency every time.

In addition to those illustrated, Link-Belt uses a heavy-duty babbitt or high-quality bronze—securely anchored in housing—for long bearing life. What's more, Link-Belt assures off-the-shelf delivery on more than 15 types and over 300 sizes of solid, split, gibbed or angle blocks for shaft sizes from ½ to 8 inches, plus related take-ups. And for special applications, bearings can be furnished with cast steel housings.

Link-Belt bearing blocks are carefully packed to assure factory-finish condition on delivery. Recessed decals identify bearing blocks by serial number and size . . . simplify ordering. Call your nearest Link-Belt office or authorized stock-carrying distributor. Refer to the yellow pages of your local phone directory.

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Date-line Diary...

May 2

△ J&L Steel Corp. Cleveland works will not resume operations May 15 as scheduled at time of shutdown, for completion of its modernization program in February. Officials stated that startup time cannot take place until more orders are obtained.

May 5

△ The Labor Dept. reported that workers drawing unemployed compensation dropped to 3,332,600 in the week ended April 19, a decrease of 30,700 from the previous week. The department also reported layoffs in manufacturing increased in March to 31 for every 1000 on the payroll.

△ Government figures showed that construction outlays in April rose to $3,700,000,000, up $400,000,000 over March, and approximately the same as in April, 1957.

△ The AISI reports that the operating rate of the steel industry for the week of May 5 is scheduled at 1,350,000 tons. This compares with 1,289,000 tons one week ago (47.8 per cent capacity) and 2,220,000 tons one year ago. Index of production for the week is 84.0.

△ The AISI reports estimated payroll for the iron and steel industry for March, 1958, amounted to $271,763,000, compared with $261,725,000 in February, 1958 and $345,180,000 in March, 1958. Estimated total employment was 539,300 compared with 554,300 in February. Average hourly payroll cost per wage earner was $3.092 plus over 30¢ fringe, compared with $3.088 in February and $2.834 in March, 1957. Average hours worked a week was 33.6 compared with 34.2 in February.

△ The Bureau of Mines reported that production of Pennsylvania anthracite for April, 1958, equalled 1,553,000 net tons compared with 1,501,000 tons in March, 1958 and 2,048,000 tons in April, 1957.

△ Allis-Chalmers Mfg. Co. report for the first quarter of 1958 showed sales amounting to $119,668,223, net earnings after preferred dividends $2,201,491 or $0.27 per share, compared with sales of $137,950,459, net earnings of $4,977,062 or $0.61 per share in the first quarter of 1957.

May 8

△ Steel scrap prices advanced $1 a ton on two industrial grades in the Chicago area.

May 9

△ The Labor and Commerce Depts. reported total employment in manufacturing lines amounted to 15,095,000, down 271,000 in mid-April compared with mid-March, despite a decrease in total unemployment of 78,000 in this period. The report also showed that nearly 2,000,000 of the unemployed at mid-April had been idle for 15 weeks or longer.

May 10

△ The AISI reports shipments of finished steel products for March, 1958 totaled 4,448,526 net tons compared with 4,262,935 tons shipped in February and 7,821,616 tons during March, 1957. Shipments for the first quarter of 1958 totaled 13,928,675 net tons compared with 22,689,781 tons during the same period of 1957.

May 12

△ Workers drawing jobless pay in the week ended April 26 totaled 3,265,700, down 66,900 from the week earlier; Labor Dept. reported that laid-off workers who exhausted their unemployment benefits totaled 230,000 in April against 191,400 in March, 1958.

△ The AISI reports that the operating rate of the steel industry for the week of May 12 is scheduled at 1,400,000 tons. This compares with 1,334,000 tons (49.4 per cent of capacity) one week ago and 2,155,000 tons one year ago. Index of production for the week is 87.2.

△ Brussels Steel Export Convention, price guide for West European steelmakers, reduced export prices to countries outside the European Coal & Steel Community. New lower prices prevailing are $90 a ton for bar steel, down $3; $92 a ton for structural steel, down $2; $92 a ton for wire rod, off $4. Hot rolled steel prices were advanced slightly to $110.50 for overseas exports, and to $109 for export to European countries not belonging to the coal and steel community.

May 13

△ Commerce Dept. reported the April personal income adjusted total at an annual rate of $342,800,000,000 compared with a yearly pace of $342,200,000,000 in March.

△ Directors of the Colorado Fuel & Iron Co. voted to omit the common dividend for the second quarter. A 2 per cent stock dividend was declared in April prior to which the payments were 50¢ quarterly.

May 14

△ AISI reported steelmaking furnaces produced 5,531,000 net tons of ingots and steel for castings during April, 1958 compared with 6,254,622 tons during March, 1958 and 9,814,780 tons produced in April, 1957.

△ American Smelting and Refining Co. reduced price of common lead, delivered New York basis, ½¢ per lb to 11½¢.

△Republic Steel Co. closed its South Chicago seamless tube mill for an indefinite period, idling approximately 500 workers. Employment at the company's facilities in South Chicago is now about 2700 compared with a normal level of about 4000.

△ Bethlehem Steel Co. Lackawanna, N. Y., reactivated two more steelmaking furnaces, and is now operaing 15 of its 35 open hearth furnaces.

△ Premium grades steel scrap prices advanced $1 in Chicago.

May 15

△ National Steel Corp. declared a divided of 75¢ per share for the second quarter of 1958, payable June 13, 1958, to stockholders of record May 26, 1958.

△ The Commerce Dept. reported that the nation's gross national product, for the first quarter of 1958, amounts to a seasonally adjusted annual rate of $422,000,000,000, down $10,600,000,000 from the last quarter of 1957, and $18,000,000,000 from the third quarter, 1957.

May 16

△ The F. W. Dodge Corp., on the basis of partial figures now available, report nonresidential contract awards rose in April in the 37 states east of the Rockies 18 per cent above April, 1957. Gains of 13 per cent in large residential contracts and 16 per cent in road-building awards were reported.

△ Kaiser Steel Corp. has substantially invested in stock of Allison Steel Manufacturing Co., Phoenix, Ariz., purchasing both common and preferred stocks and holding approximately 45 per cent of the voting stock of the company.

May 17

△ The Aluminum Assn. reported primary aluminum production in the United States during April, 1958, was 128,491 short tons compared with 137,916 short tons in March, 1958 and 139,152 tons in April, 1957.

May 19

△ The AISI reports that the operating rate of the steel industry for the week of May 19 is scheduled at 1,481,000 tons. This compares with 1,412,000 tons (52.3 per cent of capacity) one week ago and 2,212,-000 tons one year ago. Index of production for the week is 92.2.

△ The Bureau of Mines reported that the consumption of scrap during March, 1958 totaled 3,718,000 gross tons, pig iron used was 3,823,000 gross tons. This compares with 3,491,441 tons of scrap and 3,551,-679 tons of pig iron in February, 1958.

△ Shipments of iron and steel castings during March, 1958 amounted to 953,509 short tons compared with 911,253 tons in February, 1958 and 1,371,213 tons in March, 1957.

△ The Japan Iron & Steel Federation report production of steel ingots at 2,865,000 metric tons for the first three months, 1958.

△ Pig iron production in the United States for the first quarter of 1958 was at an annual rate of 14,062,-666; steel ingots and castings production was 21,959,-000 tons on this same basis.

△ Northwestern Steel and Wire Co. reports for the fiscal year ending March 31, net income of $1,489,436 which compares with $1,433,119 for the same period in 1957.

△ Ormet Corp., jointly owned by Olin Mathieson and Revere Copper, inaugurated aluminum production at a new plant on the Ohio river. The plant has five furnace lines. Ormet hopes to have all furnaces going at an annual rate of 180,000 tons by the year end.

May 20

△ Bethlehem Steel Co., at Lackawanna, reactivated one of the four blast furnaces idled two months ago, and is now operating four of its seven blast furnaces for the production of pig iron.

May 22

△ Both R. L. Gray, president of Armco Steel Corp., and Charles M. White, chairman of Republic Steel Corp., predicted price increase in steel in the wake of the July 1 contracted wage increases. Neither gave any hint of the amount of price boosts.

May 23

△ Custom smelters raised price of copper ¼¢ to 24¢ a lb.

△ Steel scrap prices in Pittsburgh moved up $1 to $3 a ton, and No. 1 heavy melting was moving at $33 to $35 a ton.

△ Machine tool orders for April decreased to $22,-800,000, which is 23 per cent below March, 1958 and 56 per cent under April, 1957.

May 26

△ The AISI reports that the operating rate of the steel industry for the week of May 26 is scheduled at 1,526,000 tons. This compares with 1,523,000 tons one week ago (56.4 per cent of capacity) and 2,252,-000 tons one year ago. Index of production for the week is 95.0.

May 28

△ Custom smelters raised price of copper an additional ¼¢ to 24¼¢ a lb.

May 29

△ President Eisenhower took a definite stand against anti-recession tax cuts now, and renewed his recommendation for extension of present corporation and excise taxes which are scheduled for automatic reduction June 30 under existing laws.

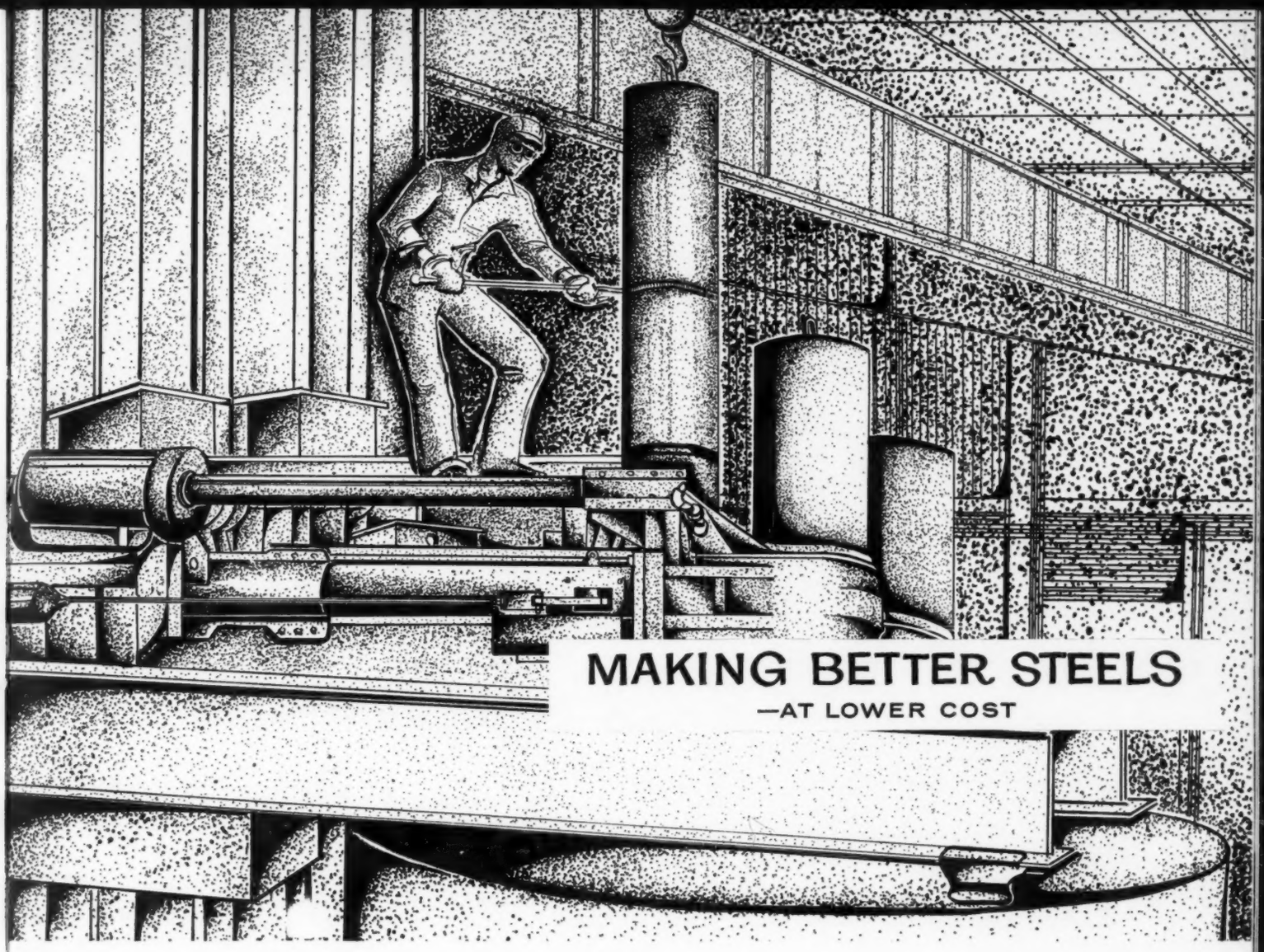
△ The SEC reported that manufacturing firms cut March quarter offering of new securities to $576,000,-000, less than half the total in the like 1957 period.

△ According to the F. W. Dodge Corp. report construction contracts in the United States in April totaled $2,881,011,000, an increase of 4 per cent over April, 1957.

△ The AISC reports that bookings of fabricated steel in April totaled 208,161 tons compared with 195,970 tons in March, 1958 and 403,576 tons in April, 1957; shipments in April, 1958 amounted to 323,574 tons compared with 336,598 tons in March, 1958 and 362,-192 tons in April, 1957.

△ The Industrial Heating Equipment Assn. reports that new orders for industrial furnaces in April, 1958, were $3,572,000, compared with $2,871,000 in March, 1958; orders for induction and dielectric heating equipment in April, 1958 were $435,000 compared with $374,000 in March, 1958.

△ A bill approved by the House Ways and Means Committee will hold corporate income and excise taxes, previously slated by existing law to decline June 30, at present levels.



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. . . to the electrode column combines the melter's art and science of knowing how and doing it right.

The joints of a **GLC graphite electrode column** are made tighter by using the **"weld-strength" Unitrode® nipple** — a revolutionary new aid to making better steels at lower cost.

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GREAT LAKES CARBON CORPORATION

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Ohio Rolls

FIRST AGAIN!

in

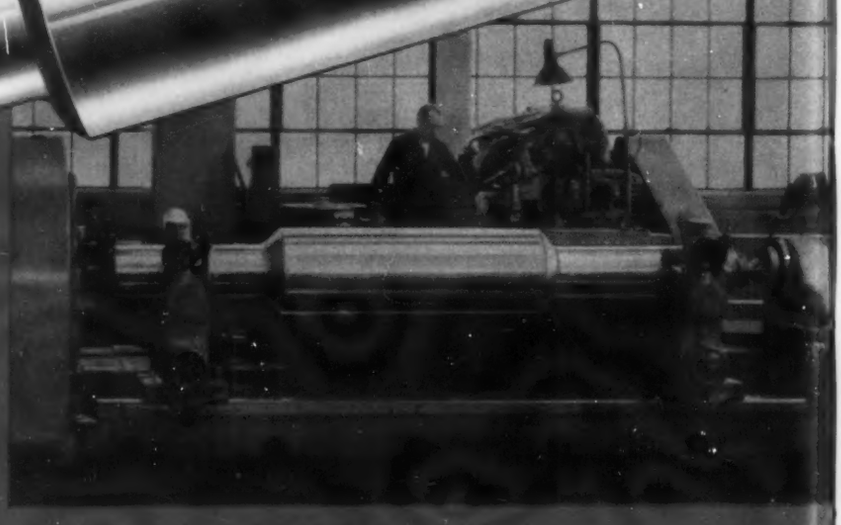
REHARDENING

and

REMAKING

too

One of Ohio Steel's induction heating units used in removing original hardening and stresses from rolls to be rehardened.



- Induction heating process (used exclusively by Ohio Steel) removes original surface hardening and stresses
- Prevents distortion of journals
- Eliminates rebuilding and re-machining journals
- Roll is reharded by progressive induction hardening and returned to mill with no change in the close tolerance dimensions of the journals.

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THE OHIO STEEL FOUNDRY CO.

LIMA, OHIO

Plants at Lima and Springfield, Ohio

LIMA... Virtually at the center of the steel industry

OR25

Ohio Iron and Steel Rolls: Carbon Steel Rolls—Ohioloy Rolls—Ohioloy "K" Rolls—Flintuff Rolls—Double-Pour Rolls—Chilled Iron Rolls—Deneo Iron Rolls—Nickel Grain Rolls—Nioloy Rolls—Special Iron Rolls—Forged Steel Rolls

Industry News...

INSTALL PRECIPITATORS ON HOMESTEAD FURNACES

△ Two new electric precipitators have been installed at U. S. Steel Corp.'s Carrie Furnaces Division, Homestead, Pa., works, to give a final cleaning to gas produced by blast furnaces Nos. 6 and 7.

Combined with dust catchers and gas washers on both furnaces, the precipitators drop the amount of solids in the gas well below allowable maximums established by the Allegheny County Smoke Control Board.

Part of a continuing corporation-wide program to reduce air pollution to an absolute minimum at its various installations, the new Carrie Furnaces' precipitators were designed and installed by Research-Cottrell, Inc.

Blast furnace gas reaching the precipitators after leaving the dust catchers and gas washers is forced to pass through narrow channels or ducts, across which an electrostatic field is maintained. The dust particles in the gas are "magnetized" by the electrostatic field and are attracted to collecting plates, which are continuously rinsed by running water. This water drains into a settling basin, where the dust is removed as a wet sludge destined to be dried and returned to the blast furnaces.

After passing through the precipitators, the blast furnace gas has a dust content so low that after the gas is burned as fuel, the final waste gas entering the atmosphere from the boiler house stack and from the blast furnace stoves is extremely clean.

PRIME STRIP PROCESSED ON NEW TOWER FURNACE

△ A combination gas and electric tower furnace recently processed prime strip steel on its first production run at Youngstown Sheet and Tube Co.'s Indiana Harbor Works Tin Mill No. 2 in East Chicago, Ind.

Designed and built by General Electric Co.'s Industrial Heating Department at Shelbyville, Ind., the six-story-high combination gas-electric furnace is used for continuous annealing tin plate steel strip in a protective atmosphere.

The new furnace is rated at 15 tons per hr for 500 fpm of 0.01-in. by 30-in. strip. It is designed for later expansion and when eventual conversion is made the capacity will be increased to 30 tons per hr at a maximum rate of 1000 fpm.

Close control of the soak-out or holding and cooling operations has been made possible with the use of electric heat. Gas is used for the heat-up section of the furnace. Extra economy has been achieved with the radiant gas-fired portion of the equipment with the use of coke oven gas.

Two features of the new unit are looping towers located at each end of the furnace. Each tower has 14 loops reaching from the floor to the structure's top. Sufficient looping, or slack, in the strip before furnace entry is necessary in order to permit welding of the coil ends without stopping the steel during its passage through the furnace. Looping at the exit end permits alternate changing of the winding wheels enabling the line to move without interruption when coils are removed.

The combination gas-electric tower furnace consists of heat-up, soak-out, cooling, fast cooling and quench chambers.

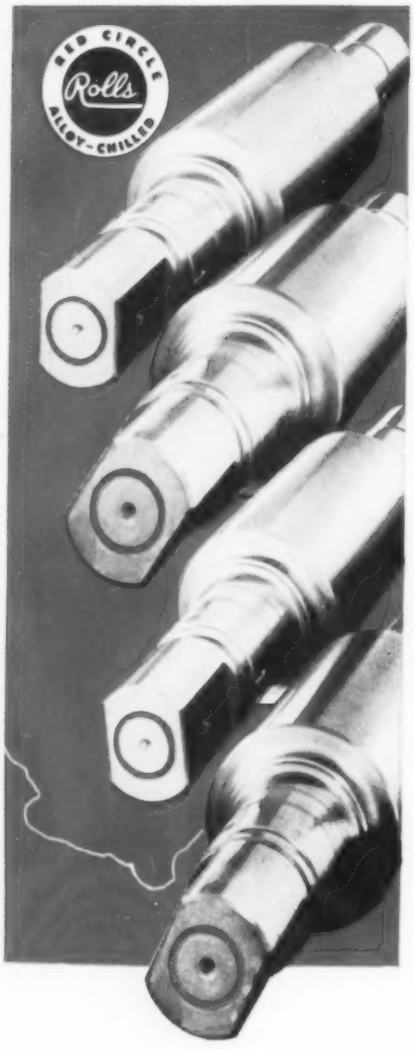
W. C. Bennett (right), Carrie Furnaces division superintendent at U. S. Steel's Homestead District Works, points out to Robert W. Graham, plant general superintendent, construction features of two new electronic precipitators designed to clean gas produced in blast furnaces Nos. 6 and 7. Added to a gas cleaning system which includes dust catchers and gas washers, the precipitators reduce the amount of flue dust in the gas to far less than maximum allowed by county smoke control regulations.

CONSTRUCTION BEGINS ON SHEFFIELD ROD MILL

△ Construction work has begun on the Sheffield Division—Armco Steel Corp.'s new $10,000,000 rod mill at Kansas City, Mo., by the Rust Engineering Co.

As general contractor for construction of the new mill, Rust will co-ordinate the design and erect the mill building and will install all mill machinery, auxiliary equipment and utilities.

Designed to be one of the fastest



Red Circle Rolls

for all purposes

The Red Circle on the Roll is the Hyde Park mark of Quality. Hyde Park makes rolls for every type mill.

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for
Finer Finish, Longer Life
and Greater Tonnage
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FOUNDRY & MACHINE CO.
Hyde Park, Westmoreland Co., Pa.
ROLLS
ROLLING MILL MACHINERY
GRAY IRON CASTINGS

10-in. rod mills in the world, it will have a speed of 6000 fpm on rods and a production rate of 80 to 90 tons per hr for bar products.

The rod mill will be located on a site adjacent to Sheffield's present plant in the east side of Kansas City.

J & L ANNOUNCES 81-TON OXYGEN CONVERTER HEAT

△ Production of 81-ton heats of steel by the basic oxygen process has been announced by Jones & Laughlin Steel Corp.

This is the largest size heat being produced by any basic oxygen furnace in the world. The larger heats allow more convenient handling of the molten steel while maintaining the same quality and versatility.

Previously, J&L had been producing 54-ton heats. Heat capacity was limited by the equipment for handling the molten steel rather than by the size of the furnaces.

The annual capacity of the J&L basic oxygen furnaces will remain at 750,000 tons, since the time factor will rise from 39 min to 55 min per heat.

The two furnaces began operations in November, 1957, at the J&L Aliquippa, Pa., Works.

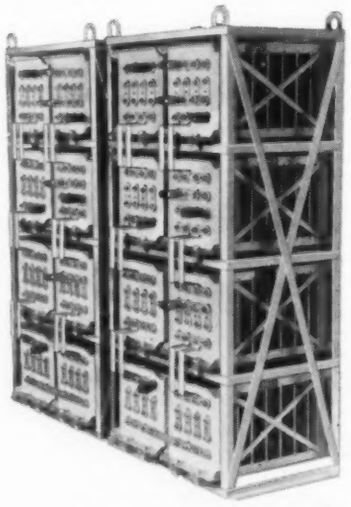
HAGAN ACQUIRES DATA LOGGING MANUFACTURER

△ Hagan Chemicals & Controls, Inc., has acquired the name and tangible assets of The Kybernetes Corp., New York, N. Y. Kybernetes, formerly a subsidiary of Self Winding Clock Co., Inc., manufactures automatic data logging and temperature monitoring equipment for industry.

Purchase price was not disclosed.

According to William W. Hopwood, Hagan president, production will continue at Kybernetes' present plant but eventually will be transferred to Hagan's instruments and controls plant in Orrville, Ohio.

The Kybernetes data logger utilizes the electronic counting principle, as opposed to the electromechanical and electronic weighing methods, to convert signal voltages to digital form.



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TO CHECK the
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Resistor
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It's the GUYAN RESISTOR!

COMPLETELY assembled Racked Resistors with all interconnecting bus bars and terminal lugs installed. Custom designed for your individual conditions.

For your *heavy service* applications we offer Helical Coil construction to end warping and buckling burnouts. *One installation proves our modern design is superior.* Write for details.

GUYAN MACHINERY CO.
LOGAN, W. VA.

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RESISTORS

Mr. Hopwood said the data logger is an ideal supplement to the company's present controls, especially the new Hagan Powrlog series of electronic instruments. The same "intelligence" signals used for control can also actuate the logging process.

Kybernetes will function as a part of the instruments and controls division, with its products being marketed through Hagan's 33 district offices in the United States and Canada.

NEW OXYGEN PLANT WILL SERVE FOUR STEEL MILLS

△ Linde Co., Division of Union Carbide Corp. will erect a 1000 ton-per-day oxygen plant and pipeline system for United States Steel Corp.

The facility will supply the equivalent of 730 million cu ft of 99.5 per cent pure oxygen per month.

It will serve four of U. S. Steel's Plants on the Monongahela River, south of Pittsburgh: Homestead; Edgar Thomson; Duquesne; and the National Works, National Tube Division. The plant will be located at the Duquesne Works and will

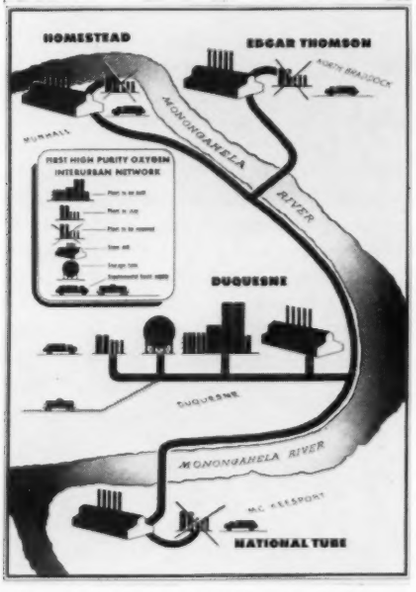


Diagram shows location of new oxygen plant at Duquesne which replaces units at Homestead, Edgar Thomson and National Tube.

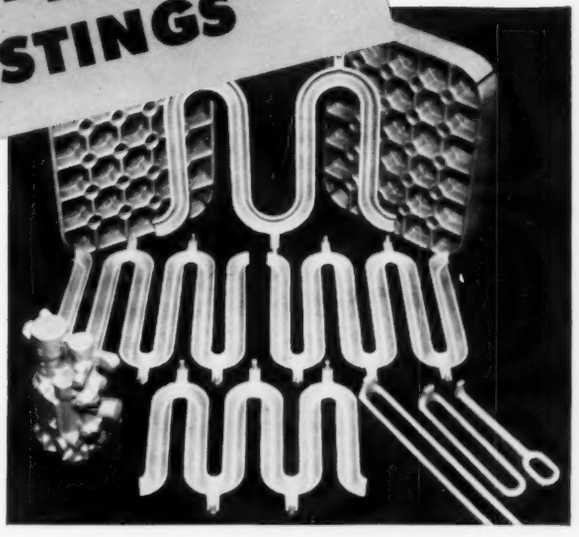
distribute oxygen to the other three by pipeline. Provision is made for future extension of the pipeline to a fifth location—Carrie Furnaces.

The new plant will replace Linde's oxygen capacity already installed at Homestead, Edgar Thomson and National Works. Last June, at

Announcing

a significant broadening of
Duraloy High Alloy Casting Service...

SHELL-MOLDED CASTINGS



DURALOY

We are now in position to accept and process substantial orders for shell-molded castings in the Chrome Iron, Chrome Nickel class.

Shell-molded castings provide several values over conventional castings:

a . . . dimensions are exceptionally accurate
b . . . thinner walls are practicable
c . . . surface finish is superior

Shell-molding is ideal for mass or repetitive production of parts particularly those with intricate design.

With our conventional static and centrifugal casting service now broadened by our shell-molded casting service, we are in a better position than ever to serve industry in connection with its high alloy casting requirements. May we quote on your casting requirements that call for shell-molding?

The DURALOY Company

OFFICE AND PLANT: Scottdale, Pa.

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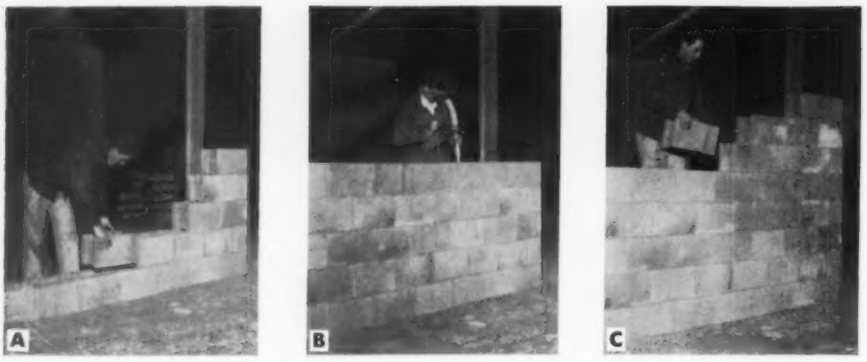
ATLANTA OFFICE: 76—4th Street, N.W.
CHICAGO OFFICE: 332 South Michigan Avenue
DETROIT OFFICE: 23906 Woodward Avenue, Pleasant Ridge, Mich.

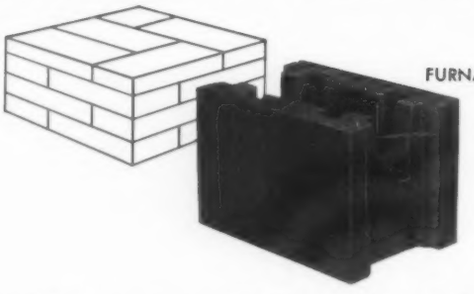


A First 5 courses of FURNACE BLOK are laid in normal pattern. **B** Moldit Castable is poured into openings in the top course of BLOK. Castable flows smoothly down and to the right and left, filling and bonding all the BLOK. No individual bonding of the BLOK is required. **C** The second 5 courses of BLOK are then laid on top of the first. These are filled and bonded as before. This is repeated until the desired height is obtained. BLOK may be cut with a masonry saw. Standard Half Blok and End Blok for corners are available.

. . . significant advance in modern refractory construction . . . monolithic walls and arches *without forms* . . . unbelievable time and labor saving—simplified construction

FURNACE BLOK*

*Patent applied for



FURNACE BLOK (9 x 13½ x 13½) EQUALS THE VOLUME OF 16 FIREBRICK.

It is possible for two men to lay and fill 120 FURNACE BLOK in one hour, or 960 per 8-hour day. Since one large BLOK equals 16 standard 9" brick, this is the equivalent of 15,360 brick laid per day, or 7,680 brick per man-day.

The average bricklayer can lay 500 9" brick per day. This means that FURNACE BLOK construction can be set up 7,680/500 or 15 times as fast.

REFRACTORY & INSULATION CORP.

R&I

REFRACTORY BONDING AND CASTABLE CEMENTS
INSULATING BLOCK, BLANKETS AND CEMENTS

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Duquesne, Linde put on-stream a 500 ton-per-day plant. However, this oxygen capacity is still not enough to handle predicted future requirements at these four works. This future demand will be filled by the new Monongahela Valley plant.

WILL BUILD NEW PIPE MILL AT LORAIN WORKS

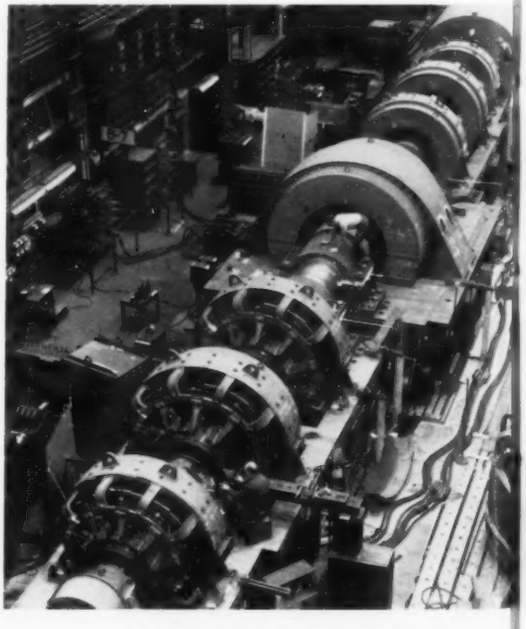
△ National Tube Division, United States Steel Corp., announced that it would construct a new continuous buttweld pipe mill at its Lorain, Ohio, Works. John E. Goble, president of National Tube, said that construction of this major facility would begin as soon as possible and completion is expected in two to three years.

The mill will be designed for production of finished pipe in a size range of 1¼ in. to 4 in. and will be the most modern continuous butt-

(*Please turn to page 173*)

GARY GIANT

The longest motor-generator set ever built by the Westinghouse Electric Corp. has been shipped to the U. S. Steel Corp.'s Gary Works. Rated at 13,500 kw, the equipment will be used to drive a 12,000-hp twin-drive mill motor and a 4000-hp edger drive motor which will operate the slabbing mill at Gary. The unit measures 86½ ft in length. The m-g set is comprised of four 2500-kw d-c generators, two 1750-kw d-c generators, a 12,000-hp wound-rotor motor, and a 127,500 lb flywheel. Completely assembled, the unit weighs 315 tons.



9½ and 34-inch by 60-inch Foil Mill at Kaiser Aluminum and Chemical Corporation, Ravenswood, W.Va.

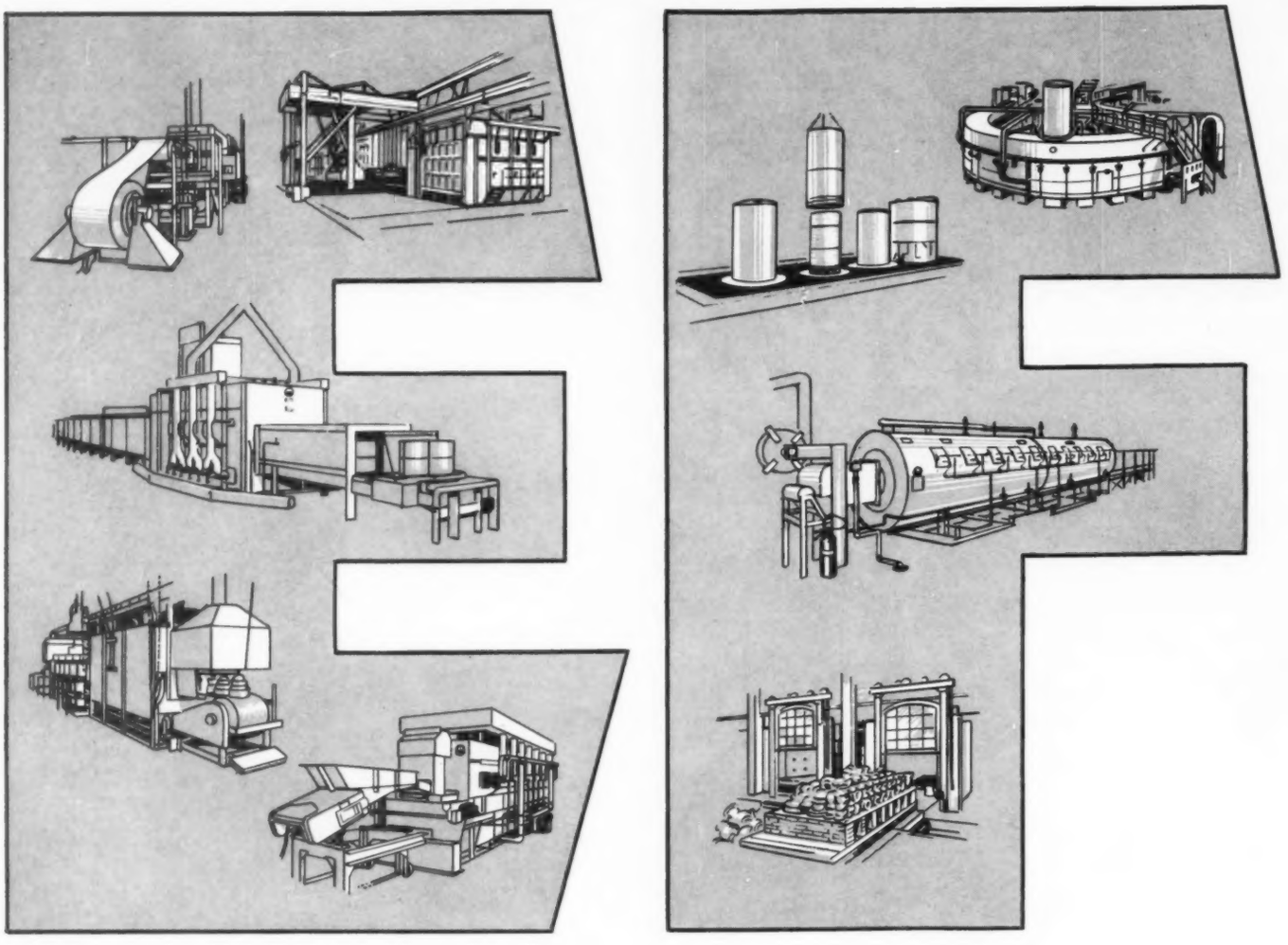
BLAW-KNOX
ALUMINUM FOIL MILLS

Blaw-Knox designs and builds a full range of Aluminum foil mills complete with auxiliary equipment to meet individual requirements. Other Blaw-Knox equipment for metals industry includes complete rolling mill installations including all auxiliary equipment for ferrous and non-ferrous metals, iron, alloy iron and steel rolls, Medart cold finishing equipment, carbon and alloy steel castings, fabricated steel plate or cast-weld design weldments, steel plant equipment, and heat and corrosion resisting alloy castings.

BLAW-KNOX

BLAW-KNOX COMPANY

Foundry and Mill Machinery Division
Blaw-Knox Building • 300 Sixth Avenue
Pittsburgh 22, Pennsylvania



Large capacity EF gas fired furnace bright annealing stainless strip. We build them electrically heated or gas fired for wide or narrow strip, for single or multiple strands.

Part of an installation of large EF gas fired three-stack rectangular bell type forced circulation special atmosphere furnaces for annealing steel strip.

EF BUILDS THE TYPE YOU WANT in the size you need-

no job is too large or too unusual

We have the engineers, the experience, the research and experimental departments and the complete manufacturing and erection facilities to build any size or type of furnace required to handle any heat treating process.

Submit your production furnace problems to experienced engineers—it pays

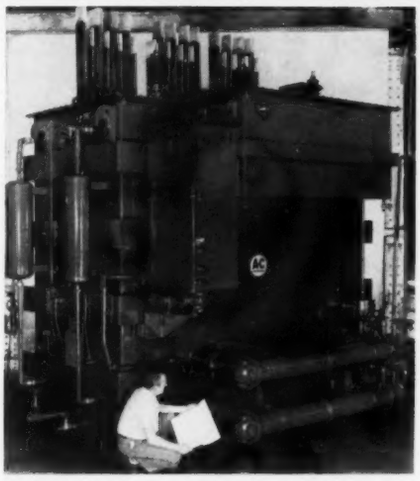
THE ELECTRIC FURNACE CO.

GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION

Salem - Ohio

Canadian Associates • Canefco Limited • Toronto 1, Canada

FURNACE TRANSFORMER



Scheduled for early installation at U. S. Steel Corp.'s Duquesne Works is this 25,000-kva forced-oil, water-cooled transformer. Equipped with a "Selectoheat" system which enables the operator to arrange tap sequences at eye level instead of through the top of the tank, the Allis-Chalmers Manufacturing Co. transformer will power a new 125-ton electric furnace. All primary taps are brought to a motor-operated changer in a separate compartment on the side of the tank. Positions on the tap-changer panels are connected to the "Selectoheat" control board. Here a series of terminals are selected and closed to set up the required heat sequence for furnace operation. When tap sequences are completed, the positions are regulated on the furnace operator's panel.

(Continued from page 170)

weld mill ever built. The new unit will be housed in a new building and includes finishing equipment and stocking and handling facilities. Capacity of the new mill will be 237,000 tons of finished pipe per year.

Mr. Goble said, "Construction of this major facility will insure a continued supply of high quality buttweld tubular products for National Tube distributors and customers in the general construction, fabricating, and conduit industries. High test line pipe will be produced for the oil and gas industry.

"The new mill will replace several older mills which are now producing buttweld pipe by the noncontinuous process."

USE THE ENGINEERING MART

THIS FROM YOUR DISTRIBUTOR

TO THIS IN YOUR PLANT THE SAME DAY:

NO MORE WAITING FOR SLING CHAINS

Gone are the days of waiting for new or rebuilt sling chains to reach you from the factory. Now, with all components furnished by your Herc-Alloy distributor, you can have your slings the same day. Leading alloy chain users are doing it. Write us or call your CM Chain Distributor for catalog, prices and assembly chart.

HOW IT'S DONE!

With ***Hammerlok*** Coupling Links, anyone who can drive a nail can assemble or rebuild a sling chain in minutes. No peening! No welding! ***Hammerlok*** is rugged ...reusable...safe. Endorsed by leading alloy chain users.

CM HOISTS AND CHAIN

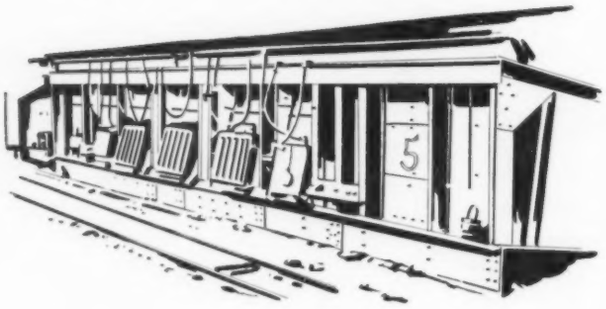
COLUMBUS McKINNON
CHAIN CORPORATION
TONAWANDA, NEW YORK
DISTRICT OFFICES: NEW YORK • CHICAGO • CLEVELAND

In Canada: McKINNON COLUMBUS CHAIN LIMITED, ST. CATHARINES, ONTARIO

HERC-ALLOY® HAMMERLOK®

BENDIX ULTRA-VISCOSON

Automatically controls fuel viscosity for highest combustion efficiency



Bendix Ultra-Viscoson* can save you money by reducing heating time, furnace maintenance and fuel costs. Viscosity is a big problem in obtaining proper atomization of fuels and uniform flame characteristics for open-hearth furnaces, steam generating power plants, and glass-melt furnaces. BLOWOUTS, SPUTTERING, and POOR COMBUSTION can all result from too low or too high a viscosity.

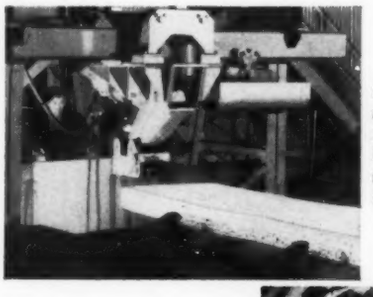
Bendix Ultra-Viscoson eliminates these problems by automatically controlling the flow of heat exchange fluid to the pre-heater. Precise control of viscosity is maintained by continuously adjusting temperatures.

For complete information, contact the Cincinnati Division, Dept. 380, 3130 Wasson Road, Cincinnati 8, Ohio. *REG. U.S. PAT. OFF.

Export Sales: Bendix International Div., 205 E. 42nd St., New York 17, N.Y.
Canada: Computing Devices of Canada, Ltd., Box 508, Ottawa 4, Ontario

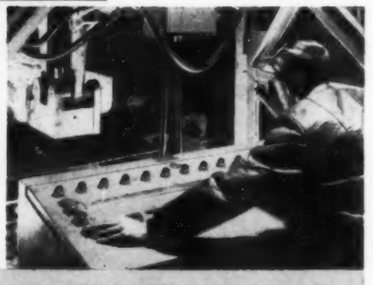
Cincinnati Division Bendix AVIATION CORPORATION

Deep, clear-cut, even impressions in slabs and blooms—*it's being done by remote control* at the 44" Blooming Mill in Jones & Laughlin's Aliquippa Works. This machine does the job better, faster, more economically, more safely than hand methods previously used. *Write for new bulletin on Remote-Control Marking.*



Slab in position for stamping with pneumatically-powered marking head. Both blooms and slabs are marked by the machine at J & L.

Any of the nine numbers in the marking head may be changed by pressing buttons on this control panel. A single button also actuates the stamping cycle.



Mecco SAFETY MARKING TOOLS

Model 701-RCW

SLAB MARKER

A Product of the Marking Device Industry

M. E. CUNNINGHAM CO.

1041 CHATEAU STREET, PITTSBURGH 33, PA.

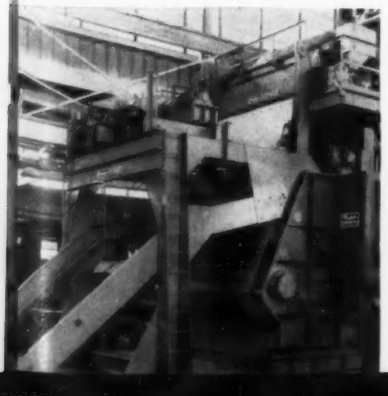
When this door comes down . . . so does your blast cleaning cost!

Abrasive-tight door on Rotoblast Barrel slashes "lost abrasive" costs

Look at it. That door on the Pangborn Rotoblast Barrel is engineered to prevent waste. Tough woven steel chain construction . . . laminated rubber back . . . edges that roll in mechanical labyrinths—it has to be abrasive-tight! As a result, here is another way that Pangborn Rotoblast Barrels save you money.

This door is just one of the many benefits built into Rotoblast Barrels. Efficient Rotoblast operation, for example. Automatic control. Ease of maintenance. Plus specific construction features that all add up to *better* cleaning in *less* time for *lowest* cost per ton.

Pangborn Rotoblast Barrel for efficient batch cleaning. Available in 1½, 3, 6, 12, 18, 20, 32, 72 and 102 cubic foot sizes.



The Pangborn Engineer in your area will be glad to take off his coat and go to work on your cleaning problem at no obligation. And for complete information on Rotoblast Barrels, write to: Pangborn Corp., *4400 Pangborn Blvd., Hagerstown, Md. Manufacturers of Blast Cleaning & Dust Control Equipment.*

Clean it fast with Pangborn ROTOBLAST®

Designed by Experience

Heavy-Duty, Cam-Operated

PUSH-BUTTON STATIONS

600 Volts
A-C or D-C

● The Euclid Electric & Mfg. Co. (Madison, Ohio) has added a complete new line of Pendant Push-Button Stations for all applications that necessitate NEMA Types 3, 4, 5 or 12 enclosures to meet weather-resistant, water-tight, dust-tight and JIC requirements. Designed for heavy-duty applications, these cam-operated Stations are rated 600 volts, a-c or d-c. They are available from one to five speed-points in each direction for a total of eight circuits to provide for practically an unlimited number of different sequences of operation.

Sturdily constructed to withstand hard usage and abuse, their small cross-section permits comfortable, non-fatiguing, one-hand operation. The extruded aluminum case has cast-aluminum side-plates that can be removed easily for inspection of the silver-to-silver contacts without disturbing any wiring. The threaded conduit fitting is an integral part of the top end-cap which also has welded to it a double-suspension cable hanger.

Extra features include heavy-duty, control-circuit toggle disconnects, pilot lights, selector switches, and maintained-type contacts.

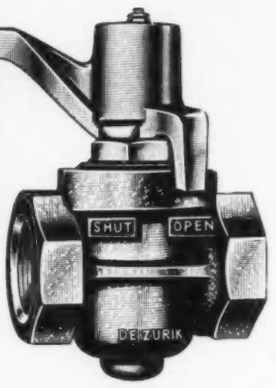
ASK FOR BULLETIN 2016

Also Available in Explosion-Proof Types.

THE EUCLID ELECTRIC & MFG. CO.
MADISON, OHIO

THE EUCLID ELECTRIC AND MFG. CO., MADISON, O.
EUCLID

GREAT GAS HANDLERS!



You get trouble-free service on blast furnace gas lines with DeZurik Valves . . . Tight shut-off . . . No Maintenance . . . Longer life . . . Low Cost!

DeZurik Valves provide more advantages than ordinary valves on blast furnace gas lines because no other valve has DeZurik's *exclusive* eccentric principle!

The plug is pivoted eccentrically in the valve body, touching the seat *only* when the valve is closed. There's no drag, no friction—just *easy* quarter-turn operation . . . without lubrication! The resilient plug-facing insures tight shut-off every time!

More steel plants are turning to DeZurik Valves every day. Why not try them on *your* blast furnace gas lines?

Ask the DeZurik representative in your area for recommendations or write to

DeZURIK CORPORATION
SARTELL, MINNESOTA.

Publication Service...

JUNE, 1958

You Can Obtain . . .

. . . any of the bulletins reviewed in the Publication Service of the IRON AND STEEL ENGINEER without obligation or cost. Simply circle the desired item numbers on one of the prepaid postal cards and mail. The requests will be forwarded to the manufacturers involved who will send the bulletins to you.

Note: Post cards expire three months after publication date.

(1) Electrode Arms and Clamps

An 8-page illustrated booklet citing the economy and safety advantages gained through automatic electrode positioning has been published by the Whiting Corp. The booklet contains an exploded drawing that details the functional simplicity, safety and economy features of the gentle arm and clamp that allows electrodes to "float *on* a cushion of air . . . be clamped *with* a cushion of air." (Bulletin EF 100)

(2) Electronic Precipitator

American Air Filter Co., Inc., has available a bulletin describing their high velocity electronic dust precipitator. The bulletin explains the cell construction of the precipitator, and lists its many advantages. A diagram showing the dimensions of this high velocity electro-cell unit is also included. (Bulletin No. 258)

(3) Transformer Catalog

Delta-Star Electric Div., H. K. Porter Co., Inc., has published a catalog describing their newly designed over-all self-protected transformer. The twelve page catalog contains close-up and cutaway photographs together with keyed text describing the many features of the new transformer. Six pages of scaled drawings and tables supply complete ordering and installing information, including high and low voltages, taps, kva, class catalog numbers, approximate dimensions, and net and shipping weights.

(4) Castings

National Alloy Div., Blaw-Knox Co. has published a bulletin on high temperature corrosion and abrasion resistant castings. The bulletin describes the production facilities and laboratory at National Alloy and illustrates typical castings produced. Of particular interest to design engineers are two tables in the brochure which give temperature properties of various heat resistant alloy castings and the composition and typical uses of National's alloys. (Bulletin 2537)

(5) Mercury Vapor Lighting

Crouse-Hinds Co. has published a bulletin describing their new explosion-proof and dust-ignition-proof mercury vapor lighting fixtures. The bulletin lists explosion-proof fixtures with five styles of reflectors, all available with or without guard. Two styles of dust-ignition-proof fixtures are also listed. (Bulletin 2705)

(6) Crane Rails

Bethlehem Steel Co. has published a catalog which combines the pictorial features of an illustrated brochure with the statistical data of a handbook. The booklet describes the manufacture of crane rails as differentiated from the railroad rail, provides directions for jointing, welding, selection of proper section, and other important information. Also included are numerous illustrations, diagrams and tables. The contents are concluded with specifications for steel used in different types of crane rails, according to conditions of use under which they are to be installed. The specifications cover open hearth carbon steel crane rails of 104-CR, 135-CR, 171-CR and 175-CR section, and fully heat-treated carbon steel rails. (Catalog 464)

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First Class Permit No. 1963, Sec. 34.9, P.L.&R. Pittsburgh, Pa.

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1010 EMPIRE BUILDING
PITTSBURGH 22, PA.

IRON & STEEL ENGINEER

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51	ATLAS CAR & MFG. CO.	BULLETIN 1283	Transfer cars
52	AUTOMATIC TRANSPORTATION CO.		Heavy duty equipment
53	BLISS CO., E. W.		Rolling mills
54	BUSSMANN MFG. DIV., McGRAW-EDISON CO.		Fuses
55	CHANDEYSSON ELECTRIC CO.	BOOKLET D-103	Low-voltage generators
56	CHEMICAL CONSTRUCTION CORP.	BULLETIN M-103	Washers
57	CONE-DRIVE GEARS, DIV. MICHIGAN TOOL CO.	BULLETIN CD-218	Speed reducers
58	CUTLER-HAMMER, INC.	BULLETINS EN64 AND EN65	Ultraflex speed packaged drives
59	CUTLER-HAMMER, INC.	EL-174	Modern control equipment
60	DELAVAL STEAM TURBINE CO.	BULLETIN 0504	Centrifugal compressors
61	DIAMOND POWER SPECIALTY CORP.		Industrial television
62	DODGE MANUFACTURING CORP.		Conveyor pulley
63	ELECTRIC CONTROLLER & MFG. CO., THE	BULLETIN 6131	Magnetic control for cranes
64	ENTERPRISE CO., THE	BULLETIN 402	Sheet levellers
65	EUCLID ELECTRIC & MFG. CO., THE	BULLETIN 2016	Push-button stations
66	HILL ACME CO., THE, CLEVELAND KNIFE DIV.		Metal shearing aids
67	LARCO, INC.	BULLETIN AC 573	Crane cab and air conditioners
68	LECTROMELT FURNACE DIV., McGRAW-EDISON CO.	CATALOG NO. 10	Lectromelt furnaces
69	LINDE CO., DIV. OF UNION CARBIDE CORP.	CATALOG F-4487	Portable cutting machines
70	MACKINTOSH-HEMPHILL DIV., E. W. BLISS CO.	BULLETIN NO. 55-A	Rotary tube straighteners
71	MINNEAPOLIS-HONEYWELL	DATA SHEET 5.2-6a	Annealing cover temperature control systems
72	POST-GLOVER ELECTRIC CO., THE		Standard and welded resistors
73	RADIO CORP. OF AMERICA		Industrial TV (Closed television)
74	RELIANCE ELECTRIC AND ENGINEERING CO.	BULLETIN F-2051	Runout table motors
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76	RUST FURNACE CO.		Furnaces
77	RUST-OLEUM CORP.		Rust preventive coating for galvanized metal
78	SHEFFIELD CORP., THE		Device that measures thickness accurately without touching the material
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80	TRABON ENGINEERING CORP.		Centralized lubricating system
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MEAD-MORRISON

UNLOADING TOWERS

Coal unloading tower built for the River and Gulf Transfer Company on the dock of the Tampa Electric Company, Tampa, Florida.

This tower incorporates the most advanced engineering refinements. A one rope progressive reeving system, hydraulic rail clamps, extendable air conditioned cab, enclosed hopper, jib crane, and dead man control all contribute to make the complete operation easier and more efficient. The patented Mead-Morrison reeving system uses one rope for both the hoisting and closing operations, increasing the rope life of the system more than 300%. The Mead-Morrison hydraulic rail clamps are provided with serrated shoes to grip the rail and do not depend on friction to hold the structure fixed to the rails. For better operator visibility when unloading ships the extendable cab is extremely advantageous. The hopper enclosure confines dust to the hopper area, greatly reducing the amount escaping to the outside.

MANUFACTURING ENGINEERS • McK • ESTABLISHED 1895

McKIERNAN-TERRY CORPORATION

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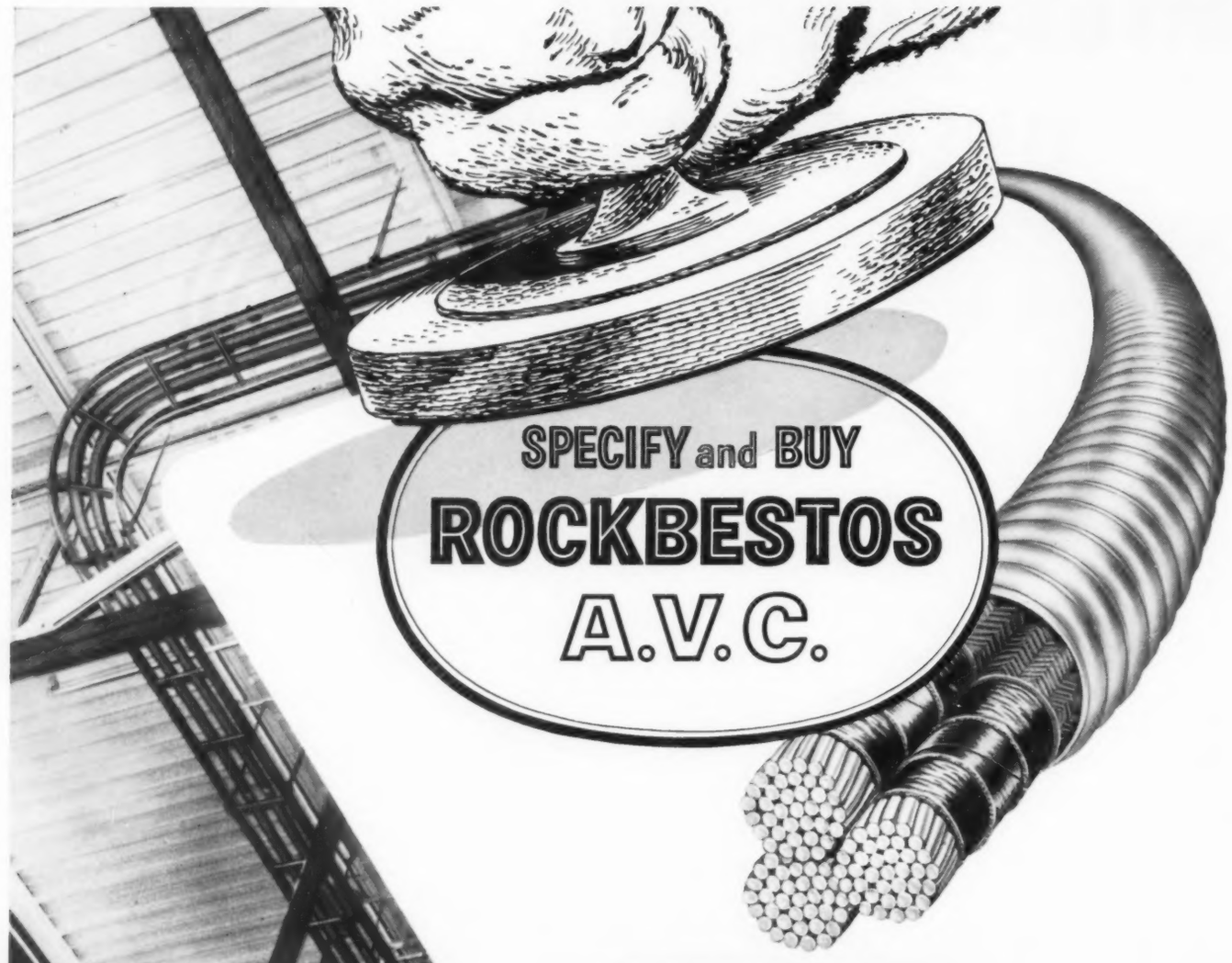
MEAD-MORRISON DIVISION • HARRISON, NEW JERSEY

WESTERN SALES OFFICE: 7 SOUTH DEARBORN STREET, CHICAGO 3, ILLINOIS



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ROCKBESTOS A.V.C.

INTERLOCKED ARMORED CABLE

For Power Distribution in New Plants or in Modernizing Old Plants For more current capacity than cable in conduit or other armored cable, *specify and buy Rockbestos A.V.C.* . . . for easy installation on racks or hangers beneath the ceiling or next to walls, *specify and buy Rockbestos A.V.C.* . . .

. . . To eliminate costly conduits and ducts . . . to save important dollars on materials and installation time, to permit quick, easy repairs, *specify and buy Rockbestos A.V.C.* . . . All interlocked armored cables are not alike . . . and, for maximum dollar-savings and maximum performance be sure to *specify and buy Rockbestos A.V.C.* Interlocked Armored Cable — the superior AVA Cable.

Write now for the new Rockbestos manual which gives the application and design data to help you *specify and buy Rockbestos A.V.C.*

ROCKBESTOS PRODUCTS CORPORATION, NEW HAVEN 4, CONNECTICUT

NEW YORK • CLEVELAND • DETROIT • CHICAGO • OAKLAND • PITTSBURGH
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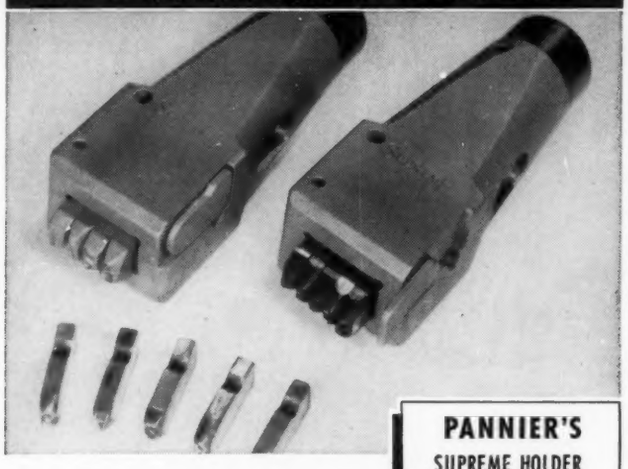
ROCKBESTOS A.V.C.

THE SUPERIOR A.V.A. CABLE

ANOTHER *PANNIER* MASTER MARKER!



New Roto-Pin type lock is integral part of *all* Pannier Supreme Holders . . . eliminates loose, bent, dropped, or lost pins . . . flip it open to change type . . . flip it back to securely lock type in clear-marking position.

PANNIER'S SUPREME HOLDER WITH ROTO-PIN LOCK

Safe, fast type changing. Holder in variety of styles. Machined from High-Grade Bar Tool Steel. Hardened anvil maintains type alignment. Striking Head of Tool Steel . . . Replaceable to add long service life to Holder.

Write for complete data.

BIRTHMARKED MATERIALS

MARKING MASTER PANNIER MARKERS DEVICES

THE PANNIER CORPORATION

302 Pannier Building • FAirfax 1-5185 • Pittsburgh 12, Pa.

Offices: Los Angeles • Chicago • Cleveland • Philadelphia • Birmingham

Metal Cutting Knives *ONLY*

We offer forty years of experience in producing the highest quality Metal Cutting Knives and skilled craftsmen working with the finest materials to exactting tolerances.

A bulletin on "Metal Shearing Aids" will be sent on request.

HILL ACME TOOLS FOR INDUSTRY

THE HILL ACME COMPANY

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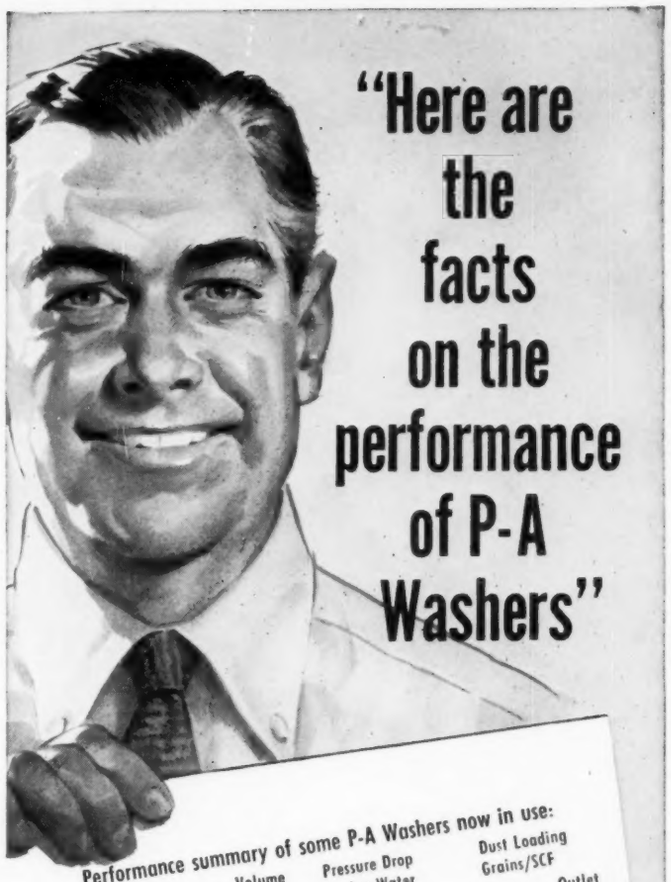
1201 West 65th St. • Cleveland 2, Ohio



"Here are the facts on the performance of P-A Washers"

Performance summary of some P-A Washers now in use:

Installation	Years Operated	Volume SCFM	Pressure Drop Inches Water	Dust Loading Grains/SCF Inlet	Outlet
A	4	78,000	30	3-19.0	.01-.04
B	3½	78,000	30	2-3	.02-.08
C	3	85,000	30-40	2-3	.01-.03
D	3	45,000	30	2	.02-.03
E	½	75,000	50	—	.02
F*	½	26,000	12	5	.10
G*	½	26,000	12	5	.10
H	½	90,000	29	—	.04

*Two units in parallel on one furnace. Lower efficiency due to lower available top pressure

These actual performance figures reflect the highly efficient operation of the Pease-Anthony washer. This venturi scrubber puts your full top pressure to work cleaning the gas. No secondary cleaner required for most installations. Present users report no maintenance problems. If you have a blast furnace scheduled for construction or rebuilding, plan now for P-A Venturi installation. Capacities up to 150,000 SCFM. Write for bulletin M-103.

CHEMICO

P-A GAS SCRUBBERS

CHEMICAL CONSTRUCTION CORPORATION

525 West 43rd Street, New York 36, New York

Telephone LOngacre 4-9400

Technical Representatives Throughout The World

Cable Address: CHEMICONST, N. Y.

YESTERDAY it wasn't there. Today, he picks it up and wonders: *why did it grow like that?* The miracle of growth! Whether it's a "toadstool" that springs up overnight or a cancer cell that suddenly comes into being, we've a lot to learn about the whole beautiful process of orderly growth . . . and the dreadful, senseless growth that is cancer.

The cancer puzzle is tied up in growth —growth of body cells smaller than the periods on this page.

Scientists, working under grants from the American Cancer Society, are ceaselessly studying cells—normal and cancer cells. And they too are asking: *Why?*

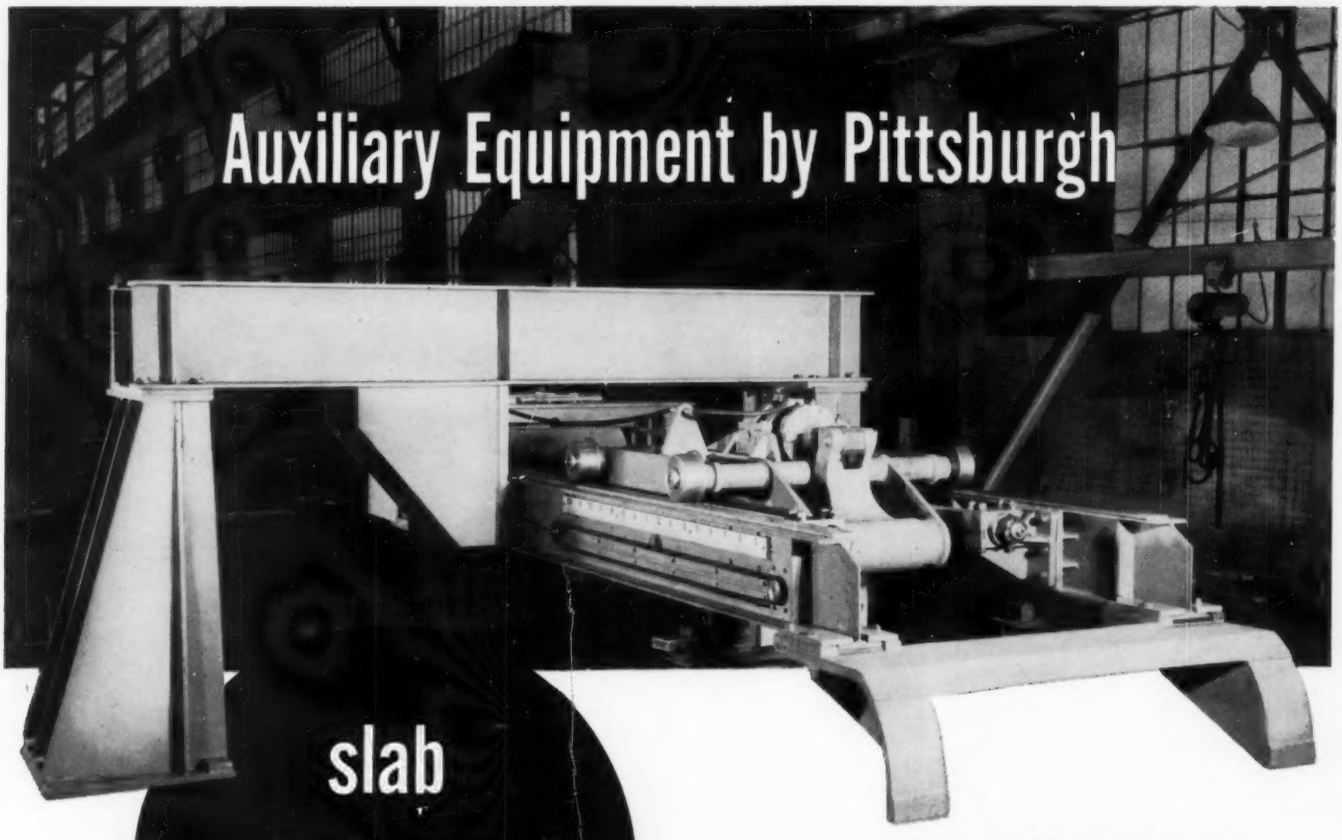
Why do cells suddenly change from normal growth to uncontrolled, disorderly growth? This question can be answered only by the most probing, painstaking and costly research.

Your contributions to the American Cancer Society will support hundreds of scientific studies necessary to save lives today and tomorrow.

Remember: Cancer can strike anyone. But you can strike back *hard* with your dollars. Send your gift to CANCER in care of your local post office.

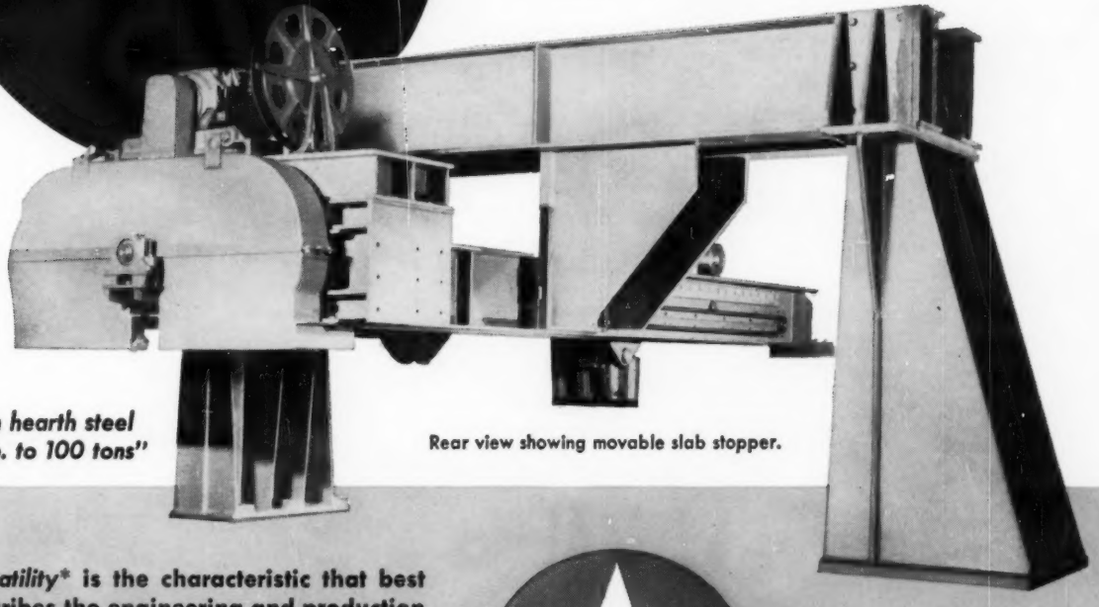
AMERICAN CANCER SOCIETY

Auxiliary Equipment by Pittsburgh



slab shear gage

Front end of gage for attachment to shear.



Rear view showing movable slab stopper.

"Electric and open hearth steel castings from 1 lb. to 100 tons"

Versatility* is the characteristic that best describes the engineering and production departments of our Company.

This Slab Shear Gage is typical of the many items of auxiliary equipment successfully designed and produced by our plant for the metal working industry. Next time you need primary or auxiliary mill equipment, contact Pittsburgh.

**According to Webster:*
"esp. ability along many lines of effort."

Pittsburgh
ENGINEERING & MACHINE

Division of Pittsburgh Steel Foundry Corporation
P. O. BOX 986, PITTSBURGH 30, PENNSYLVANIA
PLANT AT GLASSPORT, PENNSYLVANIA

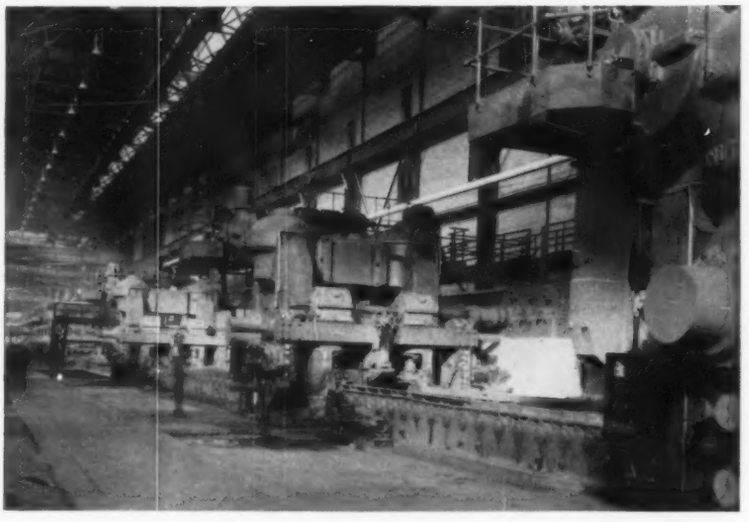
POOLE Flexible Couplings

Look at these features—many of them exclusive with the patented POOLE:

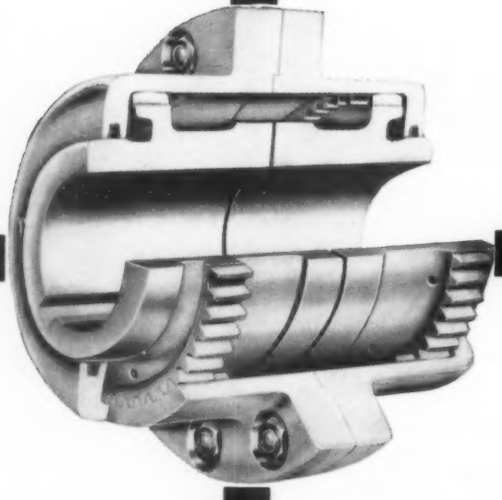
Adjusts itself to all conditions, leaving its members free to float without strain to parts.

Geared type providing great strength, the highest efficiency of modern flexible coupling design.

No flexing materials to crystallize or break . . . No welded parts . . . Filled with oil, self-lubricating . . . Oil tight, dust tight . . . Permits free lateral float . . . Stronger than shafts it connects . . . Compensates for both off-set and angular misalignment.



Steel mill drives equipped with POOLE FLEXIBLE COUPLINGS.



Get the whole story from our handbook, "Flexible Couplings." A copy will be sent gladly without obligation.

the better

FLEXIBLE COUPLING

POOLE FOUNDRY & MACHINE COMPANY

1700 UNION AVE.

BALTIMORE 11, MD.

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METAL-CLAD SWITCHGEAR

HOW MUCH DO YOU NEED A HINGED REAR DOOR?

Some switchgear makers say you don't need it at all. They say you should struggle with a 75-lb. sheet metal cover and grope for the screw holes. That's good enough for you, they say.

But I-T-E gives you hinged rear doors as standard equipment on metal-clad switchgear—at no extra cost. And many other features besides. More solid construction throughout . . . means longer life. Sturdier enclosures to simplify installation. Finer finishes to give your whole switchboard a richer look. Examine an I-T-E switchgear installation. It is just plain better built. But you pay no more.

How much do you need I-T-E's double blowout coils —standard on 15 kv circuit breakers? Under all fault currents, here is extra protection, plus assurance of longer circuit breaker life that no other switchgear offers you. Yet I-T-E charges you no more.

Recently I-T-E developed FLAMETRAP insulation that snuffs out flame in seconds and leaves no toxic fumes. It is today's most advanced flame retardant insulation—now yours on I-T-E switchgear for no extra cost.

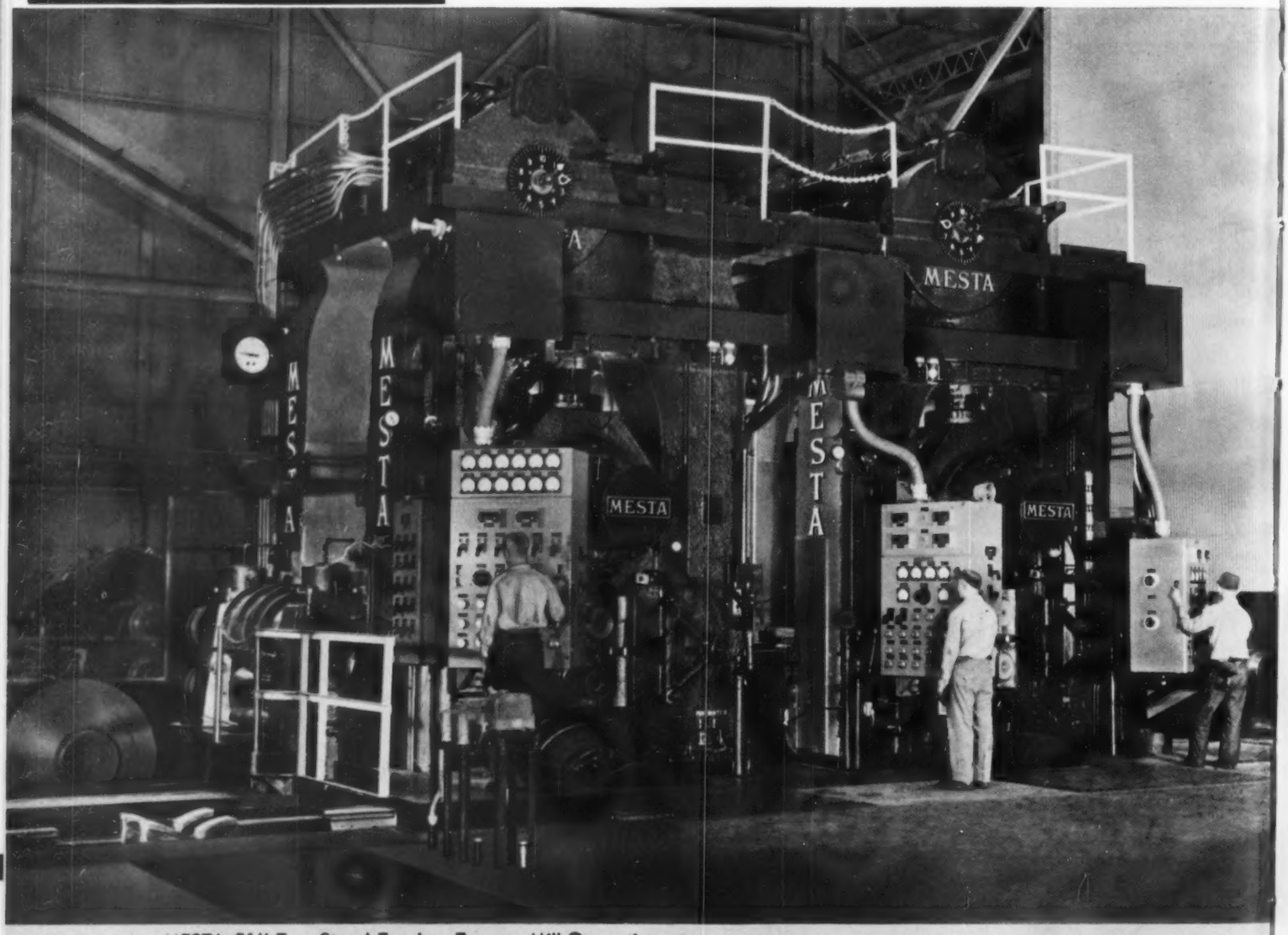
This briefly is I-T-E's policy: to make its switchgear better, in construction, performance and appearance—but to charge no more. Why not make sure that you get all the value your switchgear dollars can buy. Get I-T-E switchgear. For a complete outline of our extra-quality features, write Switchgear Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E

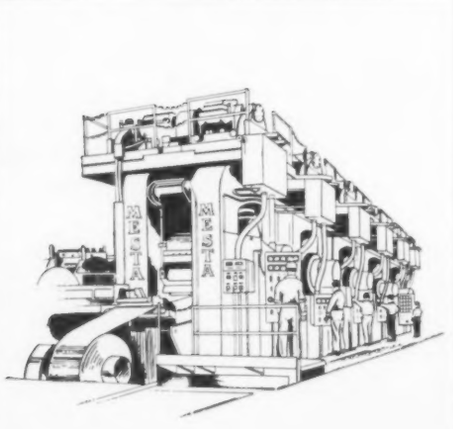
I-T-E CIRCUIT BREAKER COMPANY

PHILADELPHIA, PENNSYLVANIA

MESTA COLD MILLS



MESTA 51" Two-Stand Tandem Temper Mill Operating at the Yorkville Works of Wheeling Steel Corporation.



Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

Personnel News...

L. L. Ferrall was elected executive vice president and **J. D. Dickerson** was elected vice president—operations, Crucible Steel Co. of America. Mr. Ferrall was formerly vice president—operations and Mr. Dickerson was manager of steel production. The post of executive vice president has been vacant in recent years.

Vice president—operations since 1954, Mr. Ferrall joined Crucible in 1945 as director of metallurgy. He was named assistant vice president—operations in 1953. He began his career in the steel industry with the metallurgical department of Weirton Steel Co. in 1923. Subsequently, he served with Union Drawn Steel Co. as assistant metallurgist, the Steel and Tube Division of Timken Roller Bearing Co., where he became chief metallurgist, and Rotary Electric Steel Co., where he was chief metallurgical engineer, prior to his joining Crucible in 1945.

Mr. Dickerson joined Crucible as chief metallurgist at the company's Midland Works in 1953. He was named staff assistant to the vice president—operations in 1955 and manager of steel production in 1957. Mr. Dickerson served in various metallurgical capacities with Republic Steel Corp. He held the position of chief metallurgist at Buffalo, N. Y., from 1940 until 1953, when he joined Crucible.

John L. Neudoerfer was appointed chairman of the board, Wheeling Steel Corp., succeeding **William W. Holloway,** who has retired, after more than a quarter of a century in top management positions with the company—10 years as president and 17 years as chairman. Mr. Holloway began his industrial career in 1909 at Steubenville, in the open hearth department of La-Belle Iron Works, predecessor to Wheeling Steel Corp. Mr. Neudoerfer began his Wheeling Steel career 51 years ago and has served as president since 1950. **William A. Steele,** who has been general manager of the company's Benwood and Steubenville Works, vice president in charge of operations, and since July, 1957, executive vice president, was named president. Before becoming associated with Wheeling Steel, he was in management positions with Crucible and Wickwire Spencer.

J. L. Kerins has been appointed an assistant vice president—industrial engineering of United States Steel Corp. At the same time it was announced that **F. B. Varner** will succeed Mr. Kerins as general transportation manager of U. S. Steel and that **N. C. Halleck** will succeed Mr. Varner as assistant general transportation manager. Mr. Kerins began his career with U. S. Steel at the Duquesne Works in 1940, as a management trainee, advancing subsequently to industrial engineer. In 1945, he was transferred to the Farrell Works as plant industrial engineer and in turn moved to the Youngstown District Works as division industrial engineer. In 1948, he returned to Pittsburgh as assistant chief transportation engineer, and remained in that position until 1951, when he moved to Chicago as traffic manager—western district. In 1952 he was transferred to Pittsburgh as assistant general transportation manager—central operations, and was appointed general transportation manager in 1954. Mr. Varner started with U. S. Steel in 1941 at Mingo Junction as an industrial engineer. In 1945 he was transferred to Youngstown as an industrial engineer and remained there until 1953 when he was appointed eastern district transportation manager. He was made assistant general transportation manager in 1956. Mr. Halleck started with U. S. Steel in 1941 at the Gary Works as an industrial engineer. In 1950 he was appointed assistant plant industrial engineer, and in 1953 was made western district transportation manager.

William G. Slack was appointed superintendent of the Bar Finish and Inspection Department at the Crucible Steel Co. of America's Sanderson-Halcomb Works, Syracuse, N. Y. Mr. Slack was formerly superintendent of the Conditioning and Billet Yard at the plant. He replaces **J. F. Murphy** who retired. **Joseph G. Eckert** was named to succeed Mr. Slack. Prior to his new appointment, he was general foreman of Hot Finish Products. Mr. Slack joined Crucible in 1933. After working in the plant laboratory for eight years, he was appointed safety engineer and in 1945 he was named assistant to the works manager. He became superintendent of the Conditioning Department in 1948 and superintendent

L. L. FERRALL

J. D. DICKERSON

W. W. HOLLOWAY

J. L. KERINS

W. A. MURPHY

C. T. MARSHALL

W. D. BICKEL

J. H. KELLOGG, JR.

of the Conditioning and Billet Yard in 1955. Mr. Eckert has been with Crucible since 1929 when he joined the company as inspector in the plant's Bar Finishing Department. He became inspection foreman in 1932 and in 1934 he was transferred to the Wire Mill where he was named inspection and shipping foreman. He was returned to the Bar Finishing Department in 1940 and assigned the position of general foreman.

Wilmer A. Murphy, executive vice president of Weirton Steel Co. and vice president and director of purchases and raw materials for National Steel Corp., will retire July 1. Mr. Murphy began his career with the company in 1922 as assistant purchasing agent. In 1923 he was named purchasing agent, and in 1929 took on additional duties as assistant secretary of the company. In 1930, Mr. Murphy was advanced to secretary and in 1944 was named vice president and secretary for the Weirton Steel Division. In 1954 he was named to the National Steel post of vice president and director of purchases and raw materials.

C. Taylor Marshall, general manager, Coke & Iron Division, has been elected a vice president of Pittsburgh Coke & Chemical Co. Mr. Marshall began his career with Pittsburgh Coke & Chemical in 1942 as a laborer in the Blast Furnace Department during school vacations. He became a full-time employee in 1950, and served successively as practice engineer, supervisor—raw materials, and assistant to the executive vice president. He became manager of the Coke & Iron Division in 1955.

William D. Bickel was elected a vice president of Dravo Corp. At the same time, he was appointed general manager of the Machinery Division. Manager of the division's Engineering and Construction department since 1956, Mr. Bickel started with Dravo in 1936 as a sales engineer.

John H. Kellogg, Jr., was named manager, Special Products Division, the Electric Products Co. Since joining the company in February, 1957, Mr. Kellogg has been executive assistant to the president. He has served on the management committee and was elected assistant secretary in October, 1957.

Paul J. Pismato has been appointed superintendent of the plate mill at Kaiser Steel Corp. In his new position, he will head operations of the new 148-in. plate mill now being converted from 110-in. mill. Mr. Pismato has been with Kaiser Steel since 1943 progressing through various supervisory positions from mill provider to shift foreman and then general foreman. He was named assistant superintendent of the plate & 86-in. hot strip mills in 1954.

Edward A. Parker has been named superintendent of Kaiser Steel Corp.'s new 86-in. hot strip mill. Mr. Parker came to Kaiser Steel in 1953 as assistant superintendent of the 110-in. plate and 86-in. hot strip mills.

Wayne B. Yarnall was appointed vice president in charge of engineering and construction for the Edward Gray Corp. Mr. Yarnall has been with Edward Gray since 1955. Previously he was with the U. S. Steel Corp. as general supervisor of construction and engineering.

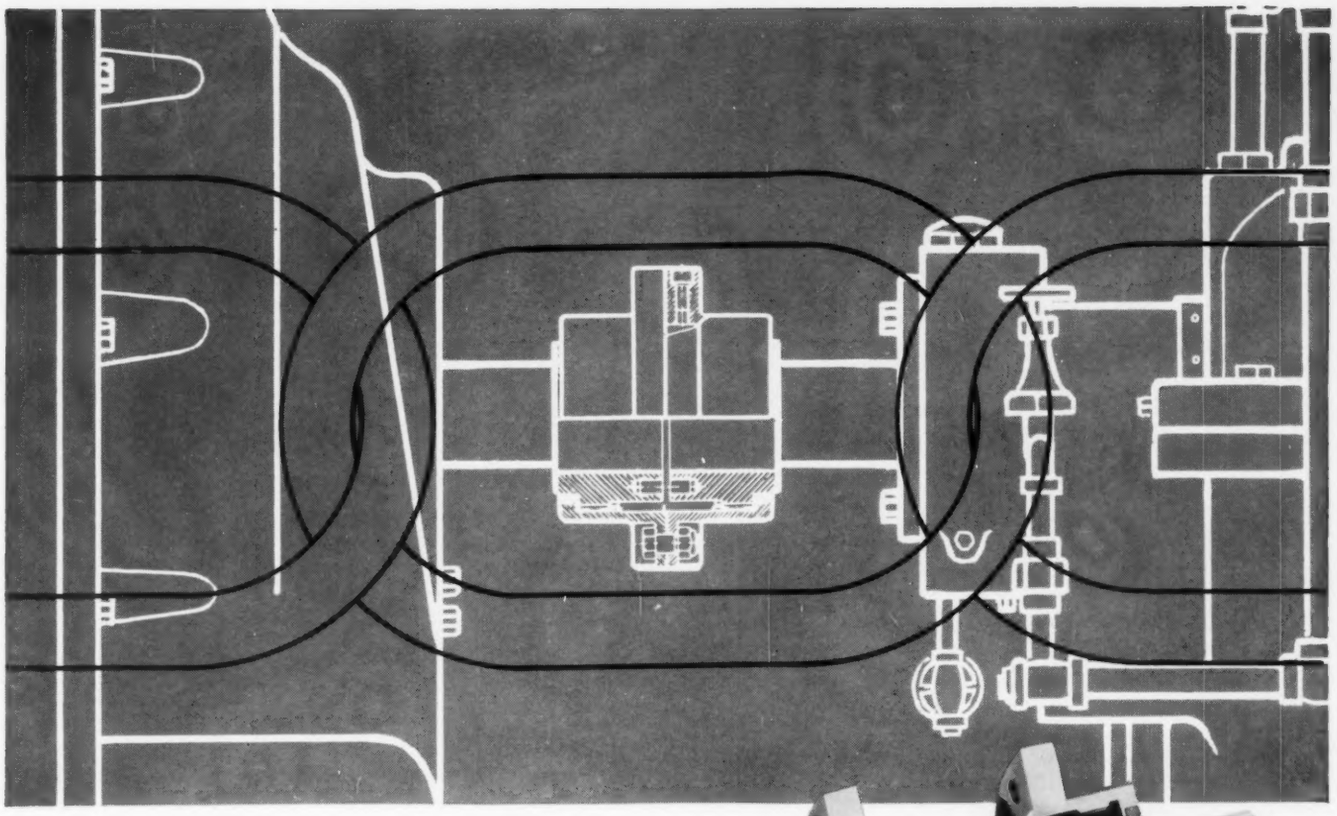
Kenneth W. Donle has been appointed chief engineer of the Tube Reducing Corp. Mr. Donle joined the company in 1951 as chief metallurgist. He was successively named manager of Cold Draw Division in 1955, manager of product engineering in 1956, and manager of quality control earlier this year, the position he held until now.

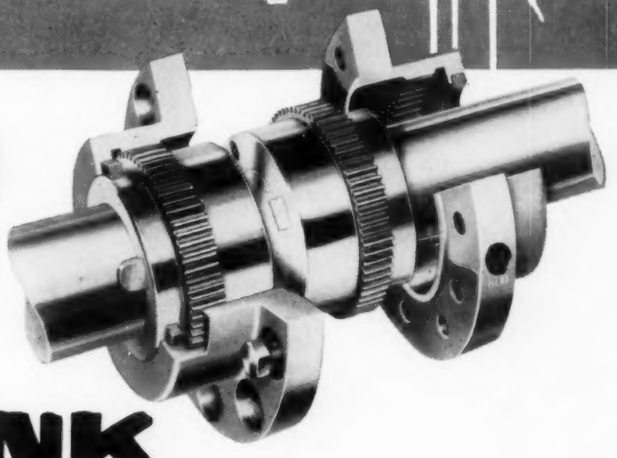
Richard E. Parrish was appointed superintendent of Engineering and Maintenance at Crucible Steel Co. of America's Park Works in Pittsburgh, Pa. Formerly chief draftsman at the plant, he succeeds **A. G. Nicola** who was transferred to the company's Sanderson-Halcomb Works in Syracuse, N. Y. Mr. Parrish joined Crucible in 1953 as a designer in the Engineering Department. He became design engineer in 1955 and the following year was named chief draftsman.

Hugh M. Bone has been named board chairman and treasurer and **A. D. Richardson Jr.,** has succeeded him as president of The Ironsides Co. **John R. McPhee** moves up to vice president and general manager, succeeding Mr. Richardson. Other officers are **John R. Barcley,** vice president; **Robert C. Williams,** vice president in charge of research and development; **Hugh H. Bone,** vice president—production; **B. G. Thompson,** vice president and **E. D. Stackhouse,** secretary and assistant treasurer.

Robert L. Kulp, formerly chief draftsman, has been named sales engineer for Reading Crane and Hoist Corp. He will cover the company's entire sales area

(*Please turn to page 192*)





FOR WELL-DESIGNED EQUIPMENT...

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POWER LINK

When a lot of time and effort have gone into the design of a piece of driven equipment, it makes sense to pick the power link carefully. Take a pump or compressor, for instance. No matter how well it is designed and built, for long service life and operating efficiency, it needs protection against strains due to misalignment.

Waldron gear couplings provide complete protection and positive, trouble-free drive because

They are strong . . . Hubs and cover sleeves for sizes 1¼A through 7A are machined from tough steel forgings. Hubs are keyed to the shafts. The two one-piece cover sleeves function as a single, rigid unit serving as a floating connecting link between the hubs. High strength of forgings makes possible a very compact coupling with low rotating inertia.

They are reliable . . . There are no flexible parts to bend or break and the coupling is dust, moisture, and oil tight. Patented Walflex seal is at the lowest possible diameter where centrifugal force is least. Clearance between teeth in hubs and sleeve is engineered so that an oil wedge always separates them, taking the wear.

They are available . . . Plenty of rough bore couplings, already assembled—on the shelf for *immediate* delivery. Finish bored standard couplings shipped to meet customers' schedules. We are geared up to give you realistic delivery on *any* type of couplings.

Ask for Catalog 57

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Cutler-Hammer presents ULTRAFLEX...the spectacular STATIC POWER

Adjustable Speed Packaged Drives

NO

WHAT'S NEW IN PACKAGE DRIVES . . .

Cutler-Hammer Ultraflex Packaged Drives provide outstanding savings in installation, operation, and maintenance

MOVING PARTS!

Ultraflex Adjustable Speed Packaged Drives offer new opportunities for quick, cost-cutting installations. Light, compact static power conversion components have replaced the conventional m-g set resulting in substantial savings in size and weight. Ultraflex Packaged Drives save up to 50% in valuable floor area . . . up to 75% in weight permitting rapid installation or rearrangement of production machinery without special handling equipment or floor loading preparations. Also, Ultraflex units require no balancing or alignment attention during installation.

Ultraflex Adjustable Speed Packaged Drives provide a new high standard of operational efficiency, ultra-responsive speed control, and ultra-precise speed regulation. No special A-c power supply is required and the exclusive Ultraflex static power conversion systems guarantee greater efficiency than ever possible with conventional drives. Further, every Ultraflex Packaged Drive works perfectly without forced ventilation which means less power is consumed as unwanted heat. Also, Ultraflex Packaged Drives are noise and vibration free.

Dependable, maintenance-free performance is one of the outstanding achievements of the all new Cutler-Hammer Ultraflex Packaged Drives. With the Ultraflex static power conversion system, there are *no* bearings to lubricate or replace when worn. There are *no* commutators to service, *no* brushes to replace periodically. There are *no* shafts to align, *no* couplings to maintain, *no* inertia loads to balance. There are *no* forced ventilation fans, *no* filters to clean or change. Ultraflex circuit components are inherently rugged and trouble-free.

Cutler-Hammer Ultraflex Packaged Drives are available in two forms . . . Ultraflex E—the 1 to 40 hp, low cost electronic type adjustable speed drive and Ultraflex M—the 1 to 200 hp, ultra-efficient magnetic amplifier type adjustable speed drive. Both forms come complete with the Ultraflex control unit, heavy-duty D-c drive motor, and operator's control station. Standard Ultraflex Packaged Drives provide an 8 : 1 speed range with wider ranges available upon request. Cutler-Hammer also provides a complete engineering service which will custom-design a static powered adjustable speed packaged drive to meet your specific requirements. Write today on your company letterhead for the new descriptive bulletins EN64-Ultraflex E and EN65-Ultraflex M. CUTLER-HAMMER Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin.

CUTLER-HAMMER
CONTROL
C-H

GET IT FIRST IN CUTLER-HAMMER

(*Continued from page 188*)

east of the Mississippi. With Reading Crane and Hoist since 1923, he became chief draftsman in 1938.

Glenn R. Smith has been appointed sales manager of Electric Service Works, Delta-Star Electric Division, H. K. Porter Co. Mr. Smith has been with Delta-Star for the last ten years. Formerly he was with the industrial sales staff of the Dupont Co.

W. Walter Renberg has been appointed assistant sales manager, Pennsylvania Transformer Division, McGraw-Edison Co. Mr. Renberg has been associated with Pennsylvania Transformer since 1947. He moves to sales from the engineering department, after serving for several years as technical product leader in charge of shell-form power transformers. His first position with the company was as an electrical design engineer.

J. H. Werner was appointed assistant sales manager of the Lee Wilson Engineering Co. Mr. Werner joined Lee Wilson in 1941, starting as service engineer and working his way up through various stages as production manager, sales engineer and, most recently, district manager—Chicago.

J. J. McGrann has been named district manager of the Los Angeles office of The Timken Roller Bearing Co.'s Steel and Tube Division. He replaces **S. Robert Kallenbaugh,** who died April 21. Mr. McGrann started with Timken in 1945 as a sales engineer in the Steel and Tube Division at Canton and was assigned to the Los Angeles office in 1946. In 1952 he transferred to the Houston, Tex., office as sales engineer and was promoted to district manager of that same office in 1953. He was made district manager of the Cincinnati, O., office in 1955, the position he held at the time of his recent promotion.

Thomas L. Denney was appointed to the position of general sales manager of The Garlock Packing Co. Mr. Denney will move from his present position of special assistant to the vice president—marketing.

W. A. Meddick, 22-year veteran of The Elwell-Parker Electric Co., was named its president and general manager. Mr. Meddick succeeds **Sheldon K. Towson,** who died in April. At the same time, **Sheldon K. Towson, Jr.,** was elected vice president and assistant general manager. Mr. Meddick joined Elwell-Parker in 1936, was subsequently named sales manager, and was

W. A. MEDDICK

S. K. TOWSON, JR.

named vice president in 1939. He has held both positions since that time. Sheldon Towson, Jr., has been with the company since 1956 as assistant to the president. Prior to that, he was associated with the Allegheny Ludlum Steel Corp.

R. E. Persohn was named general manager of Allis-Chalmers Manufacturing Co.'s Gadsden, Ala., Works. He had been assistant general manager since January of this year. Mr. Persohn joined Allis-Chalmers Pittsburgh Works in 1939 serving successively as a laboratory technician, assistant design engineer, and application engineer working on network, load center and unit substation transformers. In September, 1957, he was transferred to the manufacturing department at Pittsburgh Works.

John F. Hoffman was appointed superintendent of the Electric Weld Pipe Mill, Kaiser Steel Corp., Fontana, Calif. He succeeds **Ewald Carlson** who retired in April. Mr. Hoffman came to Kaiser Steel in 1951 as a design engineer on the staff of Plant Engineering, and in 1955 was named staff engineer. In 1956 he became tubular engineer for the Electric Weld Mill and in 1957, he was named assistant superintendent.

John R. Anderson has been promoted to assistant general manager and **Daniel L. Janoff** to chief enginee for the Materials Handling Division of Heppenstall Co. Mr. Anderson joined Heppenstall in 1953 and became manager of engineering for the Materials Handling Division in 1954. Mr. Janoff started with the company in 1950.

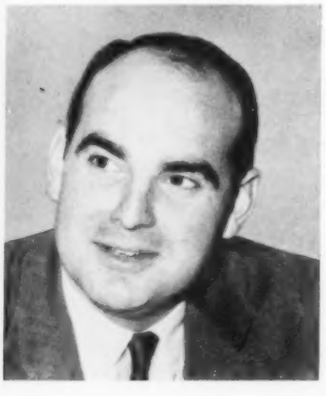
John Szuhay has been promoted to sales engineer for the Pittsburgh area of The Timken Roller Bearing

W. W. RENBERG

J. H. WERNER

J. J. McGRANN

T. L. DENNEY



SCHLOEMANN

Vertical extrusion presses for tubes and rods

Horizontal presses up to 14,000 tons, and vertical presses up to 1,250 tons power have been built by SCHLOEMANN. Their vertical extruders are well known for the good concentricity of the extruded tubes and hollow sections, and for their high production figures and low space requirements. Forty vertical extruders, sixteen of which have been built since 1950 to the latest designs, prove the advantages of the SCHLOEMANN product.

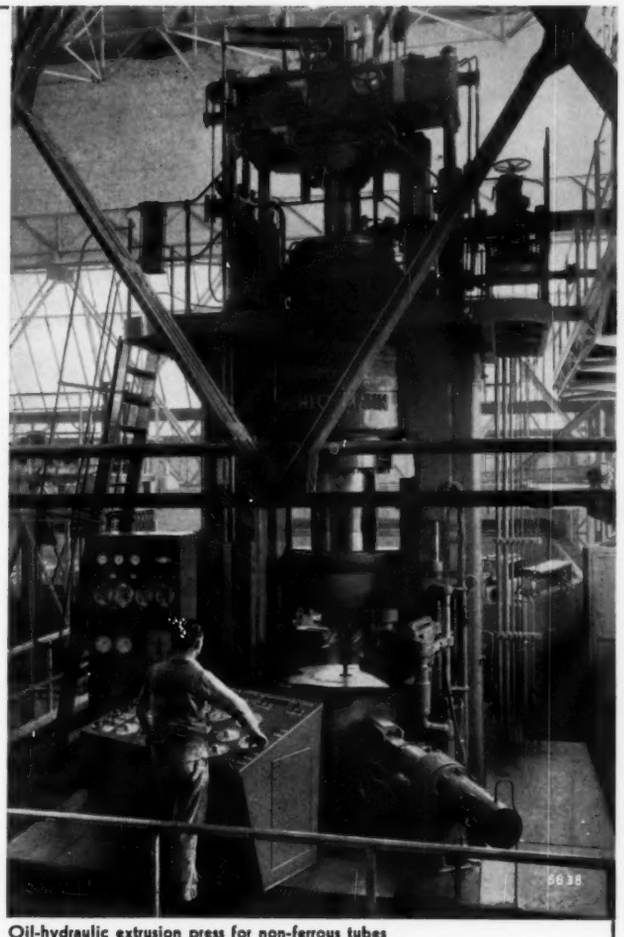
Close tolerances of the extrusions

- The main ram is guided in two widely spaced guide bushings at the ends of the cylinder.
- The piercing ram is centrally guided over the entire length of the press ram.
- The ram and container crossheads have adjustable guides, and proper alignment is not affected by billet or container heat.
- The turning device for the die holder provides for exact aligning of tools, in particular for thin-walled or 'hard to extrude' hollow sections.

Quick, economical operation

- Far-reaching mechanization of the transportation of billets, dummy blocks, butt ends and extrusions.
- Rapid changing of all tools.
- Vertically shifting container to facilitate die changing and simplify removal of the butt end.
- Inside cooling and relative stroke of the mandrel to extend its life.
- Pressure water station or self-contained oil-hydraulic pump drive; the latter is of advantage, particularly for 'hard to extrude' light metal alloys.
- Far-reaching automation by sequence control.

Numerous patents in Germany and other countries.



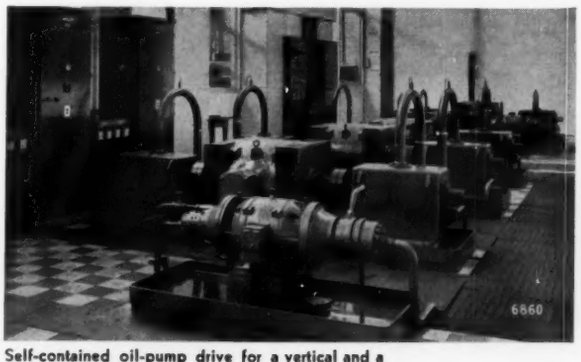
Oil-hydraulic extrusion press for non-ferrous tubes and rods with electric sequence control, power 700/800 tons, in a Metal Plant in France.

Technical data

Power of standard types.....600/700 tons
700/800–1000/1100–1230/1400 tons
1550/1760–2000/2200–2200/2500 tons

Billets.....hollow or solid
Extrusions.....tubes, rods or hollow sections
Extrusion methods "with shell" from cast billets; "without shell, lubricated" from machined billets.

Output per hour
obtained with an 800 ton press.....up to 140 tubes



Self-contained oil-pump drive for a vertical and a horizontal tube and rod press for non-ferrous metals, both built by SCHLOEMANN.

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FELLER ENGINEERING CO., 1161 EMPIRE BUILDING, PITTSBURGH 22, Pa.

Co.'s Steel and Tube Division, and **E. S. Fitzgerald** has been promoted to sales engineer at the Cleveland District office.

T. C. Graham has been promoted to contract engineer, Jones & Laughlin Steel Corp. Mr. Graham, who formerly was project development engineer at J&L's Pittsburgh Works, will serve on the staff of the corporation's chief engineer. **J. A. Kotsch** has been promoted to project development engineer at the Pittsburgh Works succeeding Mr. Graham. Mr. Kotsch formerly was chief design engineer at the Pittsburgh Works. **H. C. Ledebur** has been named chief design engineer at J&L's Pittsburgh Works succeeding Mr. Kotsch. Mr. Ledebur formerly was a planning engineer in the office of J&L's chief engineer.

Edmund Pfeifer, formerly manager of Lukens Steel Co.'s fabrication sales, was named director of purchases, the first to hold this title. Mr. Pfeifer also will serve as a member of the company's management committee. He joined the company in 1939. **E. C. Book,** purchasing agent for the last four of his seventeen years at Lukens, will serve in an advisory capacity to the director of purchases until his retirement on June 30, 1959. **Albert W. Gudal** becomes purchasing agent after serving three years as assistant purchasing agent.

John K. Beidler has been named vice president, commercial of Dravo Corp. He has been general manager of Dravo's Machinery Division since 1952 and a vice president since 1953. Prior to that he was purchasing agent for the division.

J. K. BEIDLER H. R. HILLER

Harvey R. Hiller has been appointed assistant district sales manager of Harbison-Walker Refractories Co.'s Chicago District. Mr. Hiller has been in refractories sales work for more than 30 years. He has been a sales representative in the Chicago area since he joined Harbison-Walker in 1955.

W. F. Senkus was transferred from the Chicago District sales office of De Laval Steam Turbine Co. to the headquarters Turbine Sales Department in Trenton, N. J. In his new position, Mr. Senkus, a veteran in turbine and turbo-generator sales, will assist field sales

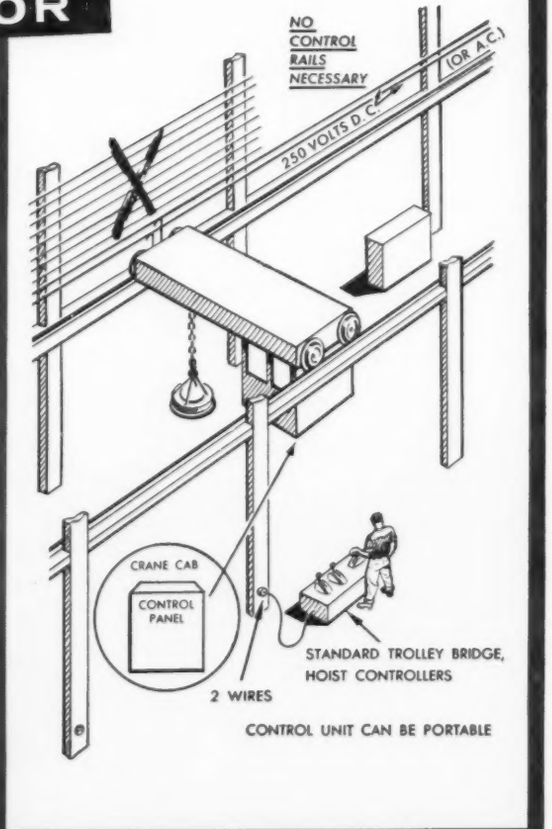
OPERATE YOUR CRANES FROM THE PLANT FLOOR

New Femco Remote Crane Control Systems

● EASY TO INSTALL ● EASY TO OPERATE
● SAVE TIME AND MONEY

You can raise or lower the hoist (5 positions), position the trolley forward or reverse (3 positions), travel forward or reverse (3 positions) and energize or turn off the magnet—all from the plant floor.

As carrier current over existing power rails is the only circuit required, installation is simple. By use of different frequencies, several cranes can be controlled on one power circuit.



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IRWIN, PENNSYLVANIA
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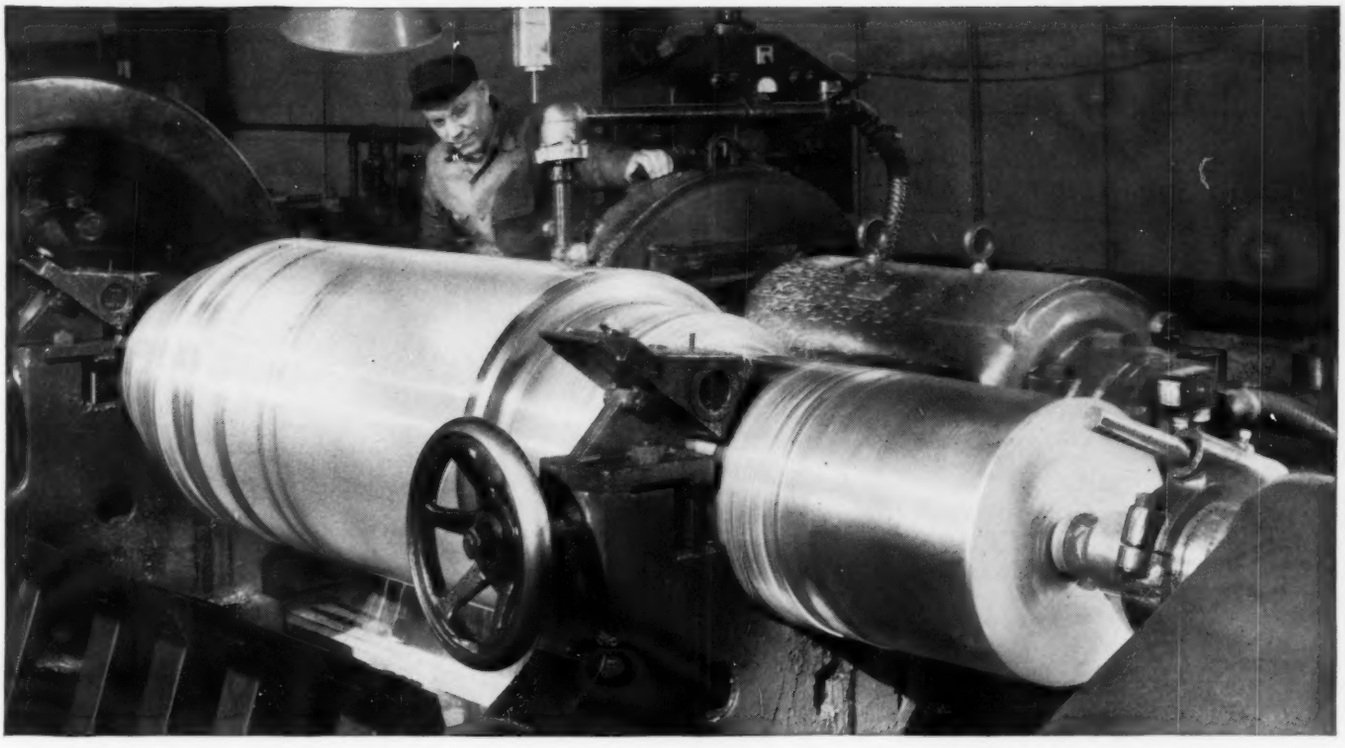
Specialists in Electronic Communication and Automation for Industry

PROGRESS IN ROLL MAKING

grinding of iron and steel rolls



NEW—

THIS PRECISION GRINDER recently installed at National is one of the largest available to the roll industry—60″ x 24′. The addition of this modern precision tool better equips National's skilled craftsmen to meet exacting requirements for precision finishing of iron and steel rolls.

Installation of the new precision grinder is a part of the extensive expansion program at National. New furnaces, new machines, new plant additions—all reflecting the growth and vitality of a new National Roll & Foundry Division designed to provide the best in iron and steel rolls.

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National Roll & Foundry Division
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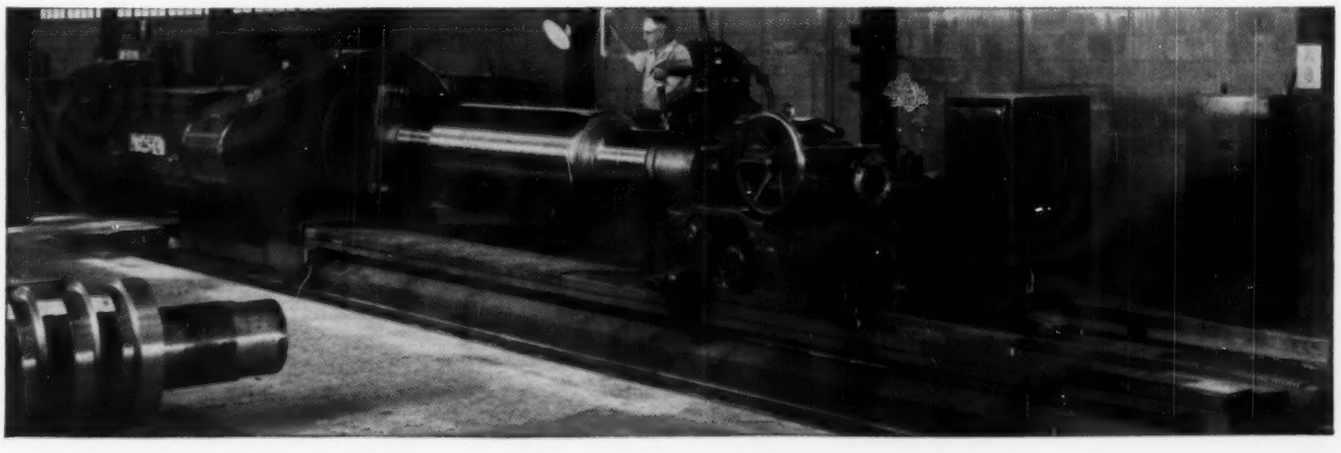
General Steel Castings Corporation: General Offices, Granite City, Ill.
Plants: Granite City, Ill. — Eddystone, Pa. — Avonmore, Pa.



offices in the promotion and sales of turbines and generators. Mr. Senkus served with the Elliott Co. before joining De Laval in 1949.

Joseph W. Timlin has been promoted to chief combustion engineer of Republic Steel Corp.'s, Warren plant. He succeeds **Paul E. Leiss** who has retired. Mr. Timlin joined Republic in 1939.

Carl E. Pfeiffer was elected a vice president of Michigan Seamless Tube Co. He will continue as general manager of Gulf States Tube Corp., a wholly-owned subsidiary.

Robert W. Remke, a practice man in the Cold Strip Department of the Granite City Steel Co., has been promoted to superintendent of the company's new Cold Rolled Finishing Department. Mr. Remke has worked for Granite City Steel for eight years.

Philip A. Gaebe has been appointed Eastern regional sales manager for the Kaiser Chemicals Division of Kaiser Aluminum & Chemical Sales, Inc. Mr. Gaebe replaces **John B. Minshall,** who is being transferred to the sales headquarters in Oakland, Calif., to serve as administrative assistant to the general sales manager.

W. O. Brown was elected vice president of sales of Crane Co. He was formerly general manager of sales after having been manager of the company's west coast sales district since 1954.

W. K. Lowe and **A. G. Nicola** received new engineering appointments at the Sanderson-Halcomb Works, Syracuse, N. Y., of the Crucible Steel Co. of America. Mr. Lowe, works chief engineer, was named to a newly created position of senior staff engineer, while Mr. Nicola, chief engineer at the Company's Park Works in Pittsburgh, was appointed to Mr. Lowe's vacated post at Sanderson-Halcomb. Mr. Lowe started with Crucible in 1922. After a series of promotions in the Electrical Engineering department, he was named works chief engineer in 1940. Mr. Nicola has been employed at Crucible's Park Works since 1951 when he was assigned the position of design draftsman. He became general supervisor of drafting in 1954 and in 1956 was named works chief engineer.

Robert J. Sloan has been elected president of Crouse-Hinds Co. He succeeds **J. R. Tuttle** who continues as chairman of the board of directors.

Stuart J. Northrop was named to the post of chief industrial engineer, Industrial Engineering Department, SKF Industries, Inc. Mr. Northrop succeeds **J. L. Listman,** who was named to the newly created position of staff assistant. Prior to joining SKF, Mr. Northrop was with Westinghouse Electric Corp.

Robert E. Latimer has joined Air Products, Inc., as assistant to the vice president of engineering. Mr. Latimer has been in the low temperature business for several years, and has been active in the design, construction and operation of cryogenic equipment and facilities.

Obituaries

William Hunt Eisenman, 73, secretary and a founder-member of the American Society for Metals, died May 30. Mr. Eisenman served the American Society for Metals for 40 years and was managing director of the National Metal Exposition and Congress. He joined the American Society for Steel Treating, forerunner of the ASM, in 1918 as national secretary.

George M. Harvey, electrical superintendent, Laclede Steel Co., and chairman of the St. Louis section of Association of Iron and Steel Engineers, died May 24. He joined Laclede Steel as an electrican helper in 1917 and was named assistant chief electrician in 1925. In 1947 he was appointed electrical superintendent of all Laclede plants and warehouses.

"MEASURAY"
MEASURES THICKNESS ACCURATELY *without TOUCHING the MATERIAL*

Hot or Cold Strip Steel, Brass, Copper, Aluminum . . . Plastics, Foils, Coated Fabrics, Film, Rubber, Etc., Even When Moving At High Speed.

Simple method—the "Measuray" shoots X-Rays through the material—measures its absorption of the rays. Calibrated meter registers plus or minus per cent of deviation from pre-determined standard. Especially useful on hot mills where material can't be checked by contact gages. Also when material can be deformed by contact such as foil.

"Measuray" is accurate to 1% of thickness or less. Quickly pays for itself in reduced scrap.

Write Today for Literature to Dept. 25, The Sheffield Corporation, Dayton 1, Ohio

the SHEFFIELD corporation
of Bendix Aviation
manufacture and measurement for mankind

NOW–ALLOY CHAIN REPAIR SERVICE

in PITTSBURGH and HAMMOND

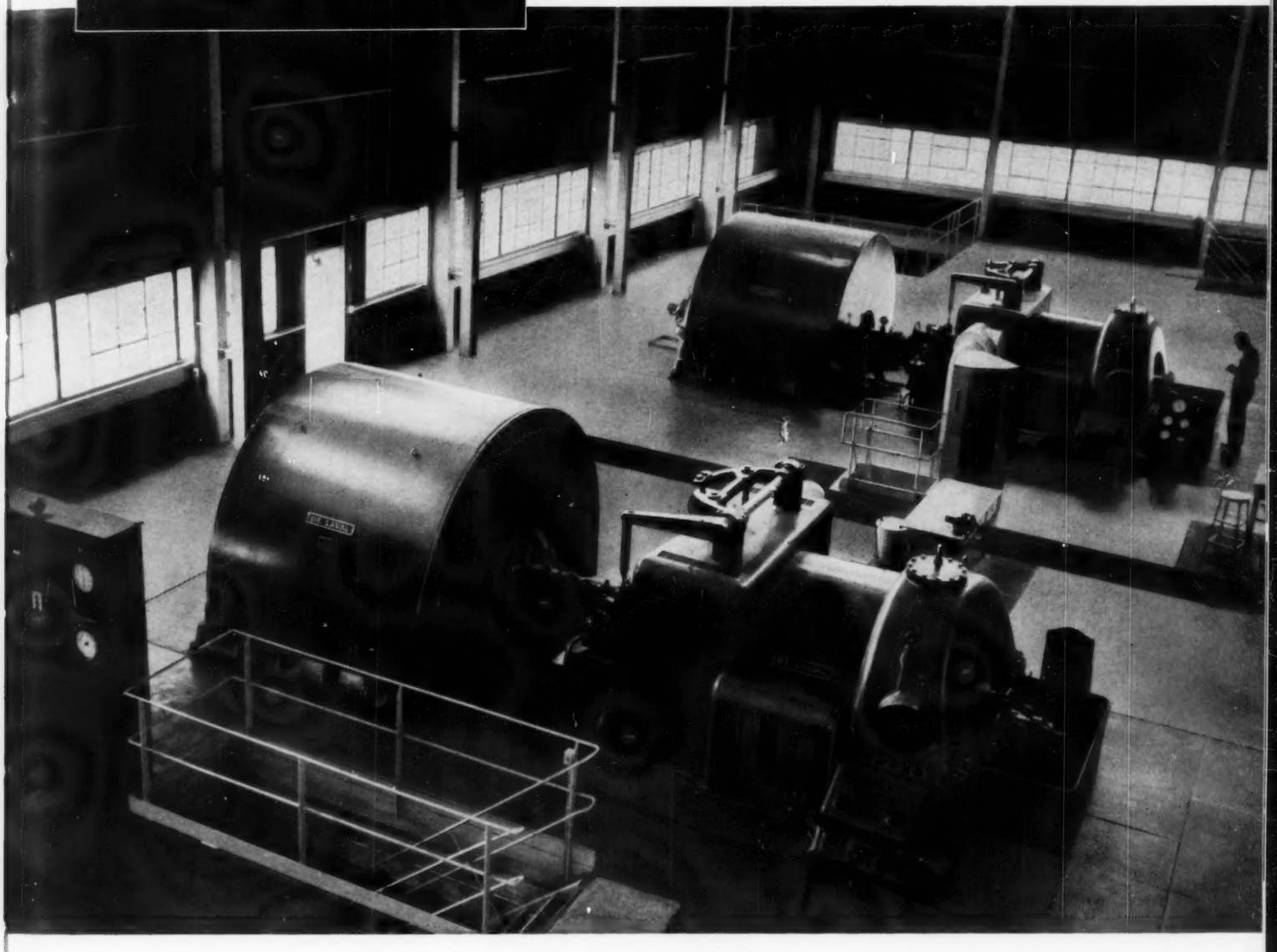
For greater safety and economy, have your Alloy Sling Chains returned to either our Pittsburgh or Hammond plant for repair, inspection and testing, at nominal cost.

S. G. TAYLOR CHAIN CO., Inc., Hammond, Ind.
and 3505 Smallman St., Pittsburgh 1, Pa.

DE LAVAL

BLAST FURNACE BLOWERS

deliver 110,000 cfm each for McLouth Steel



These two De Laval turbine-driven centrifugal blowers do a round-the-clock job in the McLouth Steel plant, Trenton, Michigan. Each has a rated capacity of 110,000 cfm of air; discharge pressure is 30 psig. Each is driven by a 12,400 hp, 2950 rpm De Laval steam turbine operating under steam conditions of 600 psig, 825 F with 2″ hg.

De Laval compressors are designed individually for each application to assure maximum efficiency and range of operation. Construction is rugged throughout. Casings and perfectly balanced rotors are built to take punishment. All parts are precision-made to limit gages. Materials are selected which will best meet the particular conditions of corrosion, pressure and temperature.

De Laval centrifugal blowers are built in single and multi-stage types to supply air in volumes up to 150,000 cfm for all classes of service in steel, gas and coke plants. The wealth of application experience acquired by De Laval over the years assures a correct and economical solution to your blower problem.

Send for Bulletin 0504

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY

870 Nottingham Way, Trenton 2, New Jersey

DL 380

TRABON

CENTRALIZED LUBRICATING SYSTEMS

It took 3 men two days to do the lubricating job Trabon now does in 5 minutes!

Trabon protects 159 bearings on this soaking pit cover crane at the Brier Hill Works of Youngstown Sheet & Tube Company. Trabon is the positive economical single line system of centralized lubrication that is famous throughout Industry for handling the roughest-toughest lubricating jobs . . . . Note close-up of Trabon pump and feeders.

Before Trabon Centralized Lubricating Systems were installed on this soaking pit cover crane, the lubrication had to be done manually to protect 159 critical bearings. It took 3 men working two days under extremely hazardous conditions to do the job. And what a job with the top cover of the soaking pit registering 300 degrees. Now, a Trabon positive system delivers lubricant from a Trabon pump to progressive feeders which distribute the exact amount of lubricant needed to all bearings no matter where located. The savings in labor, lubricant and increased production run into the thousands of dollars.

Trabon is designed for mechanical, electric motorized, hydraulic, and pneumatic operation. No other centralized lubricating system has this versatility without needing expensive auxiliary machinery. Learn for yourself why Trabon usually is entrusted with Industry's roughest-toughest lubricating jobs. Write for specifications and literature – today!

Trabon

Trabon Engineering Corporation

28785 Aurora Road • Solon, Ohio

"Centralized" OIL AND GREASE SYSTEMS "Mastrlift" CIRCULATING OIL SYSTEMS

Equipment News...

LADLE FEEDER

△ Design of a new and more automatic type of feeder for making ferromanganese or other alloy additions to the ladle while steel is being tapped, has just been announced by the Equipment Division of Blaw-Knox Co.

In its simplest form, the feeder consists of a suitable hopper, an electrical vibrating feeder, an adjustable chute and a control panel. Manganese or other alloy additions are fed at a controlled rate through the adjustable chute to the proper place in the ladle.

Basic change in the newly designed feeder is that it incorporates one or more hoppers, with each bin having a separate vibratory feeder. And, each bin is mounted on load cells of the strain gage type.

With this equipment it is not necessary to weigh alloys going into the hoppers. Through a control panel, the operator can set the unit to deliver specific amounts of one or more materials to be added to the ladle. The rate at which additions are made is also controlled. When the additions are complete the unit stops regardless of the amount of alloys remaining in the hoppers.

This unit was designed to meet increased requirements of open hearth shops which are being converted to tap larger heats on a faster cycle. While the trend toward this type of expansion has increased steel production without adding to the number of open hearth furnaces, it has resulted in a manpower squeeze.

Use of the feeder, according to user-reports, frees the furnace helpers from hauling and shoveling manganese or other alloy additives. This gives them more time to properly tend to furnace bottom and tap hole conditions.

Because the feeders are built to the electrical and space conditions of the shop in which they are to be used, they can readily be integrated in a mechanized materials handling and storage system. This practice would, according to the company, reduce the amount of expensive alloys lost in hand-handling. The hoppers on the units are normally designed to contain a sufficient quantity of additives for 24 hours of operation.

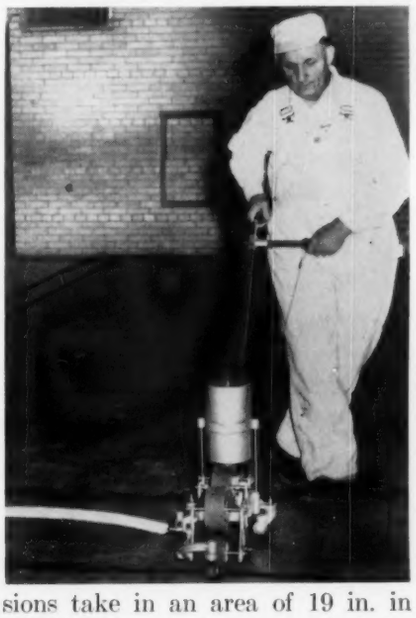
Because all pouring operations are hazardous to some extent, the safety factor is improved because the additions are controlled from a remote position.

A 600-ton heat of steel is being tapped from this furnace, equipped with a Blaw-Knox vibratory ladle additions feeder which eliminates manual handling of ferromanganese and other ladle additions. The unit, mounted on the pouring platform at the right, controls the amount and distribution of manganese going into the molten steel.

PAINT STRIPER

△ The painting of lines to mark safety aisles, storage areas, etc., in steel plants and other industrial installations is simplified by a paint striper made by the Dearborn Paint Striper Mfg. Co.

The machine is a gravity fed, roller type, friction driven unit. When assembled, over-all dimensions take in an area of 19 in. in width, 39 in. in height, and 57 in. in length. When the unit is empty, but assembled in the metal carrying case with the rollers, it weighs 45 lb. The main body is made of aluminum casting.



Some of the outstanding features of this striper are:

1. Interchangeable line widths: 1, 2, $2^1/_4$, 3 and 4 in.
2. Capable of painting (regardless of width of wheels used) lines, triangles, squares, circles and any combination of the above.
3. The paint container will hold

approximately one gallon of paint, which is capable of painting approximately 12,000 ft of 1-in. line, 8000 ft of 2-in. line, 4000 ft of 3-in. line or 3000 ft of 4-in. line.

4. When striping, it is possible to come within six inches of a wall or object.
5. Easily cleaned, stored and transported.
6. No worry about spraying or dripping on surrounding objects because paint is applied through a roller principle rather than a spray.
7. No gasoline fumes, excessive paint fumes, trailing electric wires or disturbing noises in this self-contained unit.

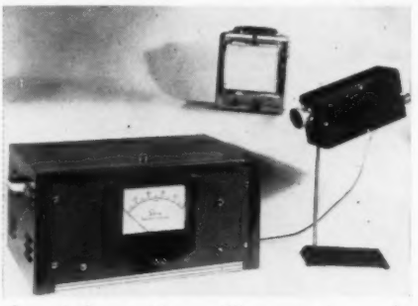
PYROMETER

△ The Shawmeter, a new type instrument which will measure the temperature of any solid, liquid or luminous flame in the 1500 to 4000 F range without need for making emissivity corrections, has been developed by Shaw Instrument Corp.

This instrument employs a radical approach to temperature measurement which eliminates human factors, provides accuracy to within 20 F and permits use of automatic controls previously considered impossible, according to the manufacturer.

As an example of the instrument's capabilities, it will measure temperature of flowing molten metals, or of moving objects in a furnace rather than the furnace temperature. Readings may be translated automatically to control processing in steel melting, annealing and heat-treating and similar applications.

The unit, a radiation ratio pyrometer, consists of two units—a sensing head for detecting radiation, and a control unit which interprets



the information. Temperature is indicated on a 7-in. meter calibrated directly in degrees. A 0–100 millivolt output is provided for operating a strip chart recorder or controller. Automatic in operation and free from deteriorating components, it has a speed of response of a fraction of a second.

Temperatures of items smaller than a lamp filament or as large as the sun can be measured. Temperature of moving objects such as sheet metal, wire or billets and molten metal streams can be determined from close to the objects or from a considerable distance.

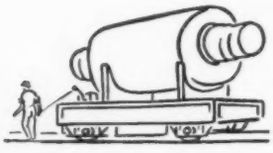
The Shawmeter also permits investigation of small temperature changes in large or small objects. It can be used to evaluate temperature of rocket and jet engines, and for combustion control of luminous flames and electric furnace heating elements.

GEAR UNIT

△ The addition of a motorized gear unit, called Line-A-Spede, to its line of integral and right angle gearmotors is announced by the Louis Allis Co.

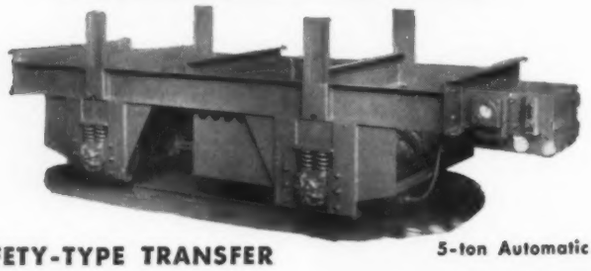
The drives are gear reducers powered by standard NEMA frame motors mounted on a shelf attached

HANDLES THE BIG LOADS WITH BIG SAVINGS



100-ton Battery Operated

ATLAS *Safety Type* TRANSFERS



5-ton Automatic Controlled

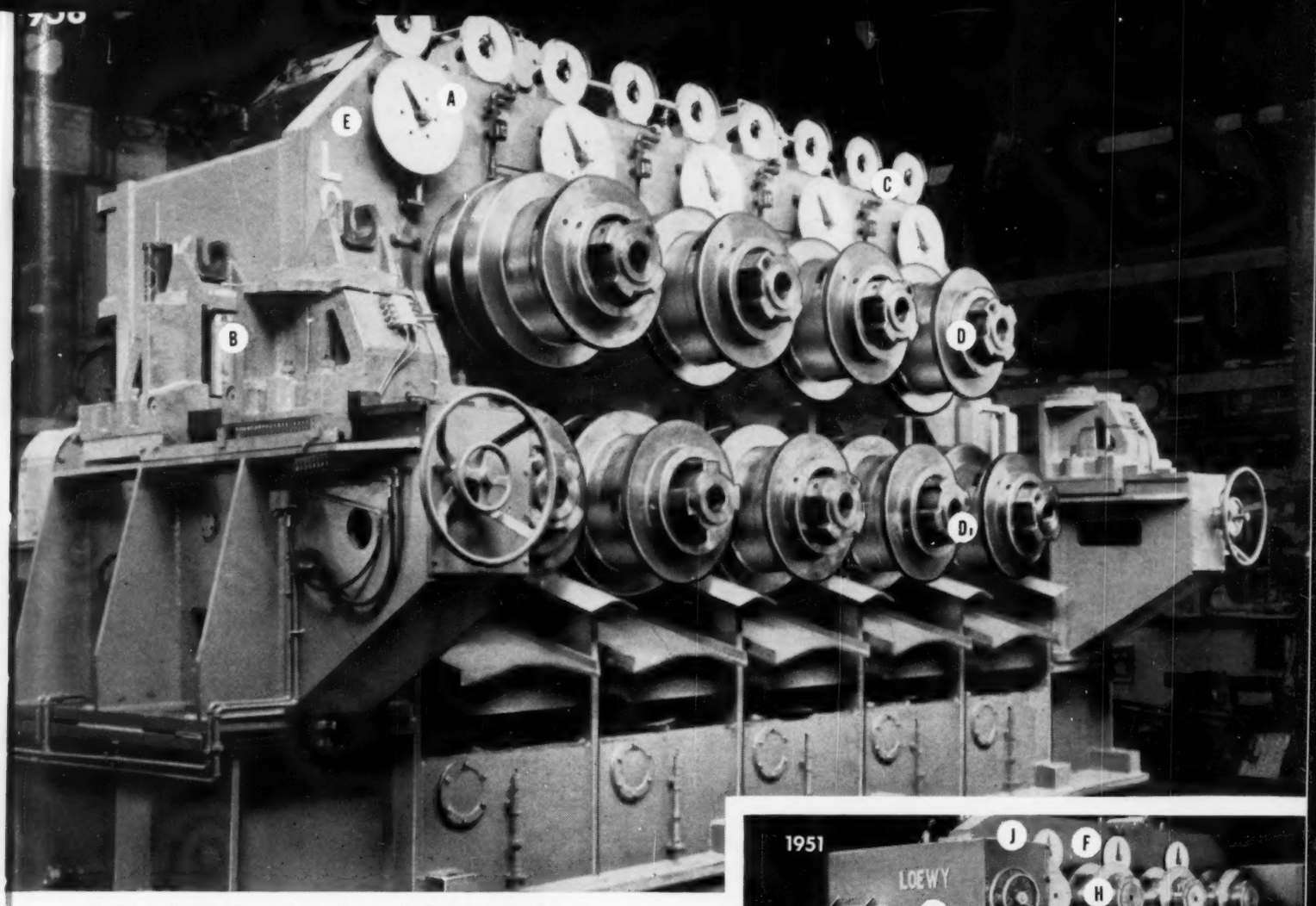
ATLAS SAFETY-TYPE TRANSFER CARS can be provided in almost any capacity for storage battery, diesel or gas-electric, or cable reel service.

They are safe because there is only one control lever, and the car moves only when the operator holds the lever.

Request "Walk-Along" Bulletin 1283.

ATLAS CAR & MFG. CO.
1100 IVANHOE ROAD
CLEVELAND 10, OHIO

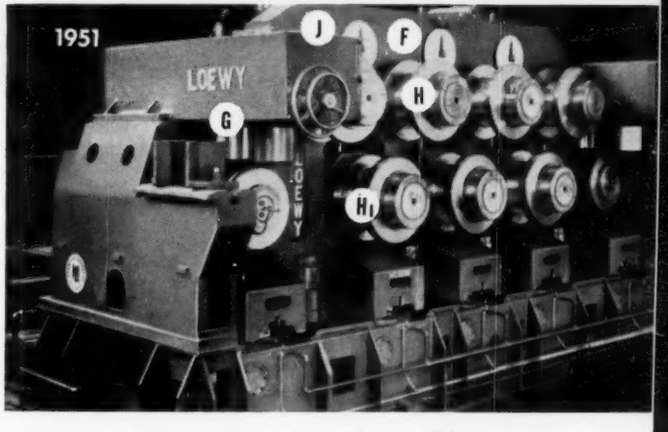
ENGINEERS AND MANUFACTURERS SINCE 1896



A. Five indicators for vertical adjustment of horizontal rollers
B. Vertical rollers supported on both ends and arranged on base-mounted sliding frame
C. Nine indicators for lateral adjustment
D, D1. Horizontal rollers bench-assembled on sleeves for quick change of program
E. All-welded steel frame

Also noteworthy: lateral movements are power operated and vertical rolls are driven by separate motor

F. Three indicators for vertical adjustment of lower horizontal rollers
G. Vertical rollers overhung and mounted on overhung bracket
H, H1. Horizontal rollers directly mounted in roller shafts
J. Cast steel frame



NOW!...

Loewy roller-straighteners for structurals and rails feature one-pass straightening at 600 fpm

In 1951 Loewy-Hydropress designed and built America's first roller-straightener with overhung straightening rolls for heavy structurals and rails—the most important development ever made in the design of straightening machines. This one-man-operated Loewy-pioneered straightener beats the slow and cumbersome gag press, which depends entirely on the operator's skill. It outmodes the closed-type straightener, which is not nearly so accessible as the open-type Loewy, does not provide the horizontal adjustment for removing camber, and requires partial dismantling of the machine for every program change.

Now we offer a machine incorporating features that further improve on the original overhung model of 1951 (see photographs above). Among the advantages are greater maximum speed—up to 600 fpm—and decrease of time required for changing rolls. By providing sleeve-mounted rolls, their assembly may be accomplished away from the machine, and thus the change of rolls can today be effected with a minimum delay for different rolling programs. Roll adjustments are now remote-control power operated and provided with selsyn-actuated indicators which show the various adjustments in the operator's booth as well as on the machine. Our machines achieve better than commercial straightness in one pass.

For more information on Loewy roller-straighteners for structural steel or on any other rolling equipment, write Dept. C-6.

Loewy-Hydropress Division
BALDWIN · LIMA · HAMILTON
111 FIFTH AVENUE, NEW YORK 3, N.Y. Rolling mills • Hydraulic machinery • Industrial engineering

BALDWIN BLH LIMA-HAMILTON

2-Roll SUTTON Straighteners

Manufactured under license from Sir James Farmer Norton & Co., Ltd., of Manchester, England

FOR PRECISION STRAIGHTENING, SIZING AND POLISHING OF METAL BARS FROM ⅛" to 9" DIA.

Accurate end-to-end straightening and sizing is achieved in one pass. Special roll designs make these machines ideally suited for straightening and polishing turned bar stock. Available in seven sizes for all modern metals.

Model No. 5
(Pictured)
2-Roll Sutton Straightener
for Bars from
2¼" to 7½" Dia.

Flexible—Easy to adjust for a wide range of sizes.

Dependable—Design backed by Farmer-Norton's 45 years' experience.

Ruggedly built—Sutton Universal Joints for trouble-free operation.

Ask for complete data

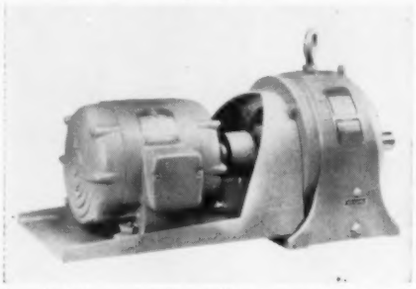
SUTTON *Engineering Company*

FIRST NATIONAL BANK BLDG., PITTSBURGH 22, PA.
PHONE: GRANT 1-8077 PLANT: BELLEFONTE, PA.

Manufacturers of Straighteners, Hydraulic Extrusion Presses, Centerless Bar Turners, Rotary Swagers, Sheet Levellers and other Finishing Machines for Modern Metals.

to the reducer. Double, triple and quadruple reduction gear units, with ratios up to 1487 to 1, are available for motor ratings of 1 to 75 hp.

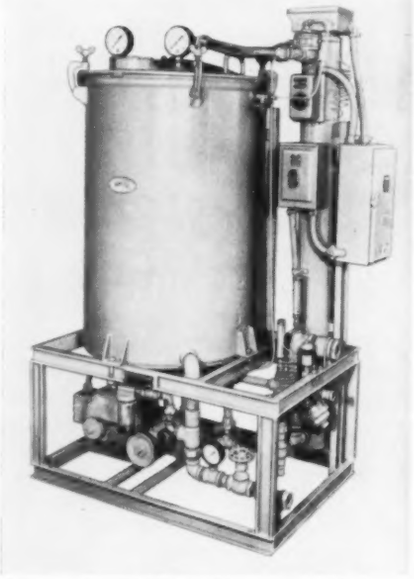
The unit is designed for installations where downtime is critical. Motors can be replaced rapidly by disconnecting the coupling between motor and reducer. In multi-unit gearmotor installations of similar rating, stand-by protection is afforded by one stand-by motor of the largest size required.



Units are available for horizontal, vertical, flange, incline, sidewall or ceiling mounting. A backstop, to prevent reversed rotation, is an optional feature. The gear portion is also available separately without motor or mounting shelf.

OIL CONDITIONER

△ A new self-contained system for vacuum dehydration of oils is in production at Bowser, Inc. The system named Fil-Thermo-Vac was developed to dehydrate, filter and de-aerate lubricating, insulating, cooling, hydraulic and other industrial oils.



Recommended for oils to 5000 S.S.U. viscosities, the system is said to accomplish dehydration to a near zero point while removing 99 per

cent of micro-fine solids and entrained or dissolved air and gases.

Oil at suitable operating temperature is forced by atmospheric pressure through fiberglas filter elements and dispersed into a vacuum chamber where free, emulsified and dissolved water and other low range volatiles together with air and gases are exhausted.

Solid contaminants are contained within the inside-out filter elements and a cooling jacket condenses the steam and vaporized contaminants which are then automatically ejected.

GATE VALVE

△ Announced by the Crane Co. is a newly designed line of 200-lb bronze gate valves.

Feature of the new valves is the modern, cylindrical body which provides considerably greater resistance to line distortion and internal pressure. New, expanded-type, chromium steel alloy body seat rings cannot loosen in service. Wear-resistant wedge disk is easily replaced.

The valves are offered in both the rising stem and nonrising stem patterns in sizes $^1/_4$ through 3 in.

TIMER

△ Development of a new synchronous motor-driven timer has been announced by Cutler-Hammer Inc. The new device is available with one-, three- and five-minute timing units.

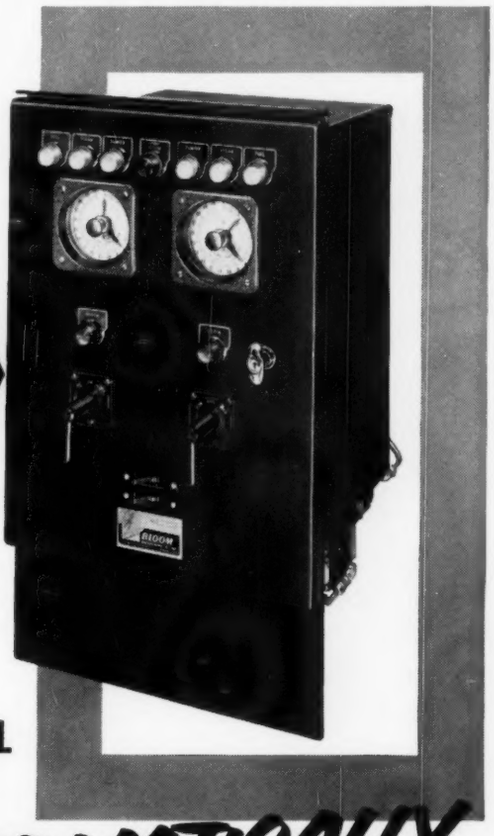
A wide range of settings is offered by this timer. The one-minute unit is adjustable in one-second increments, 0 to 60 sec; the three-minute unit is adjustable in three-second increments, 0 to 180 sec and the five-minute unit is adjustable in five-second increments, 0 to 300 sec.

A bronze pointer is depressed and rotated to the desired position on the indicating dial and the timer is set; ready to perform consistently and with repetitive accuracy. The complete visibility of the indicating dial assures precise settings and accurate timing.

An exclusive terminal board and mounting base combination provides complete and easy interchange of the dimensionally identical timing units. Quick-make and quick-break contacts in the timer's housing, made with terminal strips on the mounting base to eliminate all interwiring. These two spring contacts are protected by a male stilt structure on the back of the timing unit which plugs into female sockets on the mounting base. This feature not only facilitates interchanging and replacing but also prevents incorrect assembly and completely protects the spring contacts.

The synchronous (clock-type)

The BLOOM Time-Cycle Reversal Unit

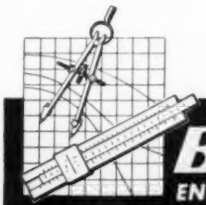


assures FULL, FAST AND EFFICIENT REVERSAL OF REGENERATIVE FURNACES AUTOMATICALLY

This complete, compact, factory-tested unit provides a combination electric-pneumatic system for Open Hearth Furnace and Soaking Pit reversal. It eliminates reversal puffing and shortens reversal period. (10 to 15 seconds easily accomplished).

Shorter reversal cycle improves furnace life.

These units have been in continuous service for nine years. Trouble-free maintenance.



BLOOM ENGINEERING CO., INC.
837 W. North Avenue Pittsburgh 33, Pa.

WRITE or phone for complete information on the Bloom Time-Cycle Reversal Unit.

A trainee taught us some ABC's

At a briefing of trainees one of the boys asked: "Can I buy U. S. Savings Bonds through the Company and have my deductions made automatically?" Frankly we had assumed that all of our employees knew all about the Payroll Savings Plan.

As a matter of fact, we've had the Plan in operation here for years. We decided to make sure that *everyone* on our payroll got full information, right away.

Our State Savings Bond Director saw to it that we got a full stock of promotional material to stimulate interest in U. S. Savings Bonds. After that he helped us to conduct a personal canvass and give everyone an application blank.

What happened next was surprising. Our employee participation jumped to a really substantial percentage. When our people had all the facts they were glad to gain the security that U. S. Savings Bonds offer them.

Today there are more Payroll savers than ever before in peacetime. Your State Director will be happy to help you install a Payroll Savings Plan or build enrollment in one already existing. Look him up in the phone book or write: Savings Bonds Division, U. S. Treasury Dept., Washington, D. C.

IRON AND STEEL ENGINEER

THE U. S. GOVERNMENT DOES NOT PAY FOR THIS ADVERTISEMENT. THE TREASURY DEPARTMENT THANKS, FOR THEIR PATRIOTIC DONATION, THE ADVERTISING COUNCIL AND THE DONOR ABOVE.

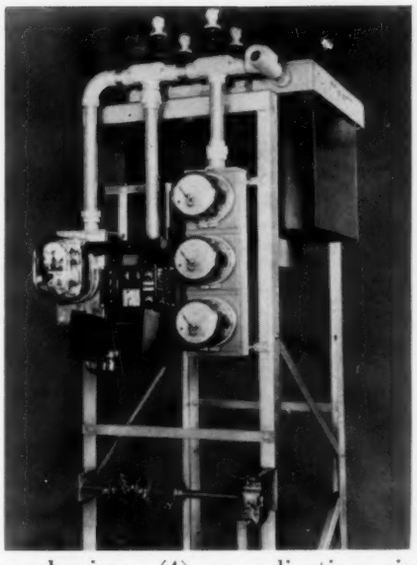
motor operates on 110 volts, 60 cycles. For 220-, 440-, or 550-volt, 60-cycle service, a control transformer and terminal block is added. In all instances the interchangeability feature applies.

POWER RECLOSER

△ A new 560-ampere power recloser (560-PR) for small and medium size suburban substations having twice the interrupting capacity of the 400-ampere power recloser (400-PR) is now available from the Westinghouse Electric Corp.

The 560-PR has an interrupting capacity of 8000 amperes at 14.4 kv and 12,000 amperes at 4.8 kv. The minimum interrupting time is $2^1/_2$ to 3 cycles. The basic mounting dimensions, tank bushings, operating and relaying mechanism, and accessories of the 560-PR are the same as the 400-PR.

The unit contains many advantages: (1) standard breaker condenser-type bushings with a choice of eyebolt or four-bolt tongue-type terminals; (2) a multiflow "De-ion" grid; (3) 220-volt motor closing



mechanism; (4) an adjusting air dashpot; (5) two 600/5 or one 600/5 and one 1200/5 standard bushing-type current transformers; (6) $2^1/_2$ to 3 cycles opening time to prevent conductor damage.

On the 560-PR, either side may be used for "line or load." The power recloser contains a short circuit ground relay that is adjustable down to a sensitivity of 40 amperes. When necessary, a ground trip sensitivity of 20 amperes can be supplied.

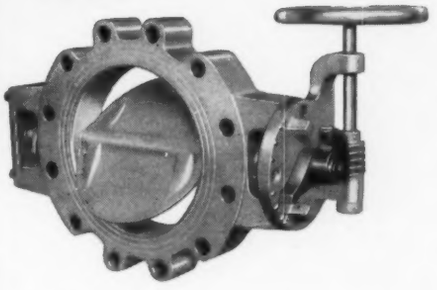
SALI Insulating Bushings
For Electrical Conduit and Boxes

Certainly they cost more!

Why settle for less? The steel mills for twenty-five years have depended on them to safeguard their production life-lines where wires emerge from conduit.

THE Adalet MANUFACTURING COMPANY
14300 LORAIN AVENUE • CLEVELAND 11, OHIO

ROCKWELL WAFER BUTTERFLY VALVES



For dependable flow control and wedge-tight shut-off of air, gases, steam and any liquids or semi-solids at pressure differential to 150 psi—

For use in power generating, cooling, refrigerating, dust collecting, compressing, processing, refining, gas transmission, combustion control, waste disposal and water works—

For easy, space-saving installation at lower cost.

They're built for HEAVY DUTY

- Slim-trim—compact.
- Smallest face-to-face dimension; require but one set of flange bolts.
- Lightweight but rugged.
- Made of any metal or rubber-lined.
- Use any manual or automatic operators.
- Standard sizes—4" to 36"; special smaller and larger sizes.

Bulletin 580 tells how they meet your needs.

W. S. ROCKWELL COMPANY
2428 ELIOT STREET
FAIRFIELD, CONN.

A remote control box, substation frames, meters, sampling valve, extra bushing current transformers, oil level dip stick or visible oil level gage, and other accessories are available for the power recloser.

MULTI-SERVICE GREASE

△ Socony Mobil Co., Inc., has announced a new multi-service grease which combines the advantages of many different greases into one product.

The new product, Mobilplex EP can be used in many different machines in place of a variety of special-purpose greases. Fewer lubricants mean simpler handling, storing and dispensing, reduced inventories, less chance of error in application, simpler lubrication charts and greater ease in training new lubrication personnel.

In the past two years, more than 400,000 lb of this product have been tested in industrial plants and proved successful under wet, dry, hot, cold, high-speed and extreme pressure conditions, with both plain and anti-friction bearings—even under conditions where foreign contaminants may be encountered.

Light tan in color, the new product is a calcium-EP-complex grease which withstands extreme pressures, has long service life, is water-resistant and at the same time maintains chemical stability despite temperatures from minus 15 to plus 300 F. It also protects against rust and corrosion, is compatible with other types of greases, lasts longer and lubricates better than conventional products.

DRUM SWITCH

△ A new drum switch for starting, stopping and reversing small a-c and d-c motors has been announced by the Allen-Bradley Co. The Bulletin 350 switch is furnished in surface mounted NEMA Type 1 enclosures, or with an oiltight cover plate for cavity mounting in a machine base.

The switch has a newly designed, wrap-around cover which completely exposes the switch mechanism for easy wiring. In addition, terminal screws are accessible from the front instead of from the side. The edge of the enclosure base is raised so that

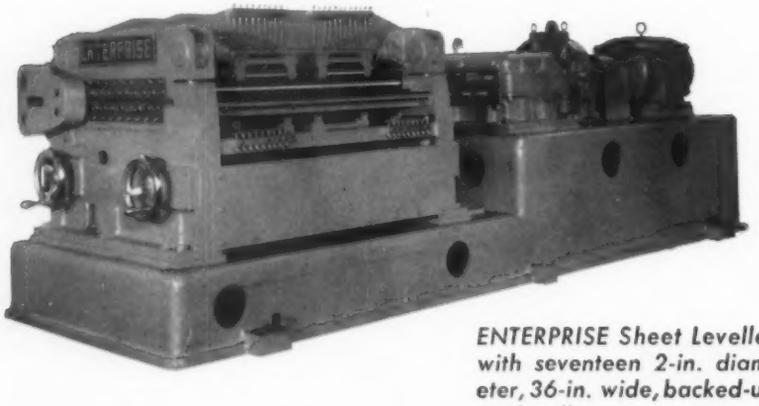
the wrap-around cover can be slipped off or on directly from the front, when the unit is mounted on its base. Thus, spacers are not needed for base mounting.

Changeover to momentary or maintained contacts is simple. With the cover removed, the locking screw on the operation selector plate is loosened, and the plate is moved to right or left. The locking screw is then retightened.

(*Please turn to page 208*)

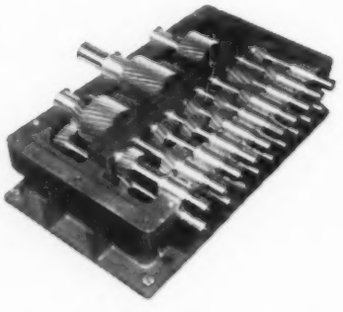
In SHEET LEVELING it's ENTERPRISE that counts

For the metal stamping industry, ENTERPRISE Roll-Type Sheet Levellers handle sheet and plate up to ¾"—level accurately, and also remove scale.



ENTERPRISE Sheet Leveller with seventeen 2-in. diameter, 36-in. wide, backed-up work rolls.

Bronze work roll bearings, anti-friction back-up roll bearings, hardened alloy steel rolls and gears, powerful brushing rolls and automatic sheet spray, circulating lubricating system—plus 80 years of engineering design experience—guarantee the long life and dependable performance of these machines.



Helical Pinion Box for ENTERPRISE 17-roll Sheet Leveller.

WRITE FOR BULLETIN #402

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CONSULTING ENGINEERS located in New York City seeking graduate metallurgical engineer with 10 plus years integrated steel mill operating experience. Some travel required. Submit resume, salary requirements, etc. All replies kept confidential. **Box 602, Iron and Steel Engineer, 1010 Empire Building, Pittsburgh 22, Pa.**

PRODUCTS

Equipment News

(*Continued from page 206*)

The switch mechanism is mounted separately from the enclosure, so that external forces that may distort the enclosure cannot cause binding in the switch. In addition, the independently mounted switch can be removed from the enclosure to provide clearance for fishing or pulling wires. Two conduit openings are provided in the base. The rotor on the switch is molded in one piece. Sections cannot get out of position, and the movable contact terminal block serves as a shield, preventing wires from coming in contact with moving parts.

The new oiltight cover used for cavity mounting is provided with a rubber flange gasket and O-ring seals on the shaft to effectively exclude oil and coolants.

The drum switch is available for 1½ hp, 110 v; 2 hp, 220 v, single phase motors; 2 hp, 110–220–550 v, polyphase motors; and ¼ hp, 115–230 v, direct current motors.

SWITCHGEAR

△ A new line of indoor and outdoor 4.16-kv horizontal drawout metal-clad switchgear (Type D) designed for greater ease in installation, maintenance and operation has been announced by Allis-Chalmers Manufacturing Co.

A feature of the line is a new "Ruptair" power circuit breaker (Type MA) with improved interrupting characteristics to meet such needs as a 2-cycle operation.

The switchgear is only 72 in. high, has eye-level instrumentation and shoulder height accessibility of auxiliary equipment.

Current transformers are mounted in the new switchgear in a separately grounded metal barrier accessible from the breaker compartment. This arrangement eliminates the need for disturbing any insulated buswork to change current transformers or for deenergizing the main bus to change current transformers.

The high quality core steel spirally wound toriodal or window type current transformers have compensated fully distributed secondary winding for metering accuracy. Because of their position in front of the automatic shutters, these transformers can be tested with maximum operator safety. The completely insulated primary breaker bushing also serves as the primary bar.

The "tilt-out" potential transformer or control power transformer can be mounted in the top rear of the standard 72-in. high breaker unit or auxiliary compartment. Cast epoxy resin is used as insulation between the primary and secondary windings of the molded potential transformers to provide corona control with less space between coils than with conventional dry or compound filled type units.

The switchgear's standard carriage will mount up to three potential transformers or a control transformer up to 15 kva. Trunion mounted, the carriage rotates 180 degrees from the connected to the disconnected position. During the one-half revolution disconnecting motion, the transformer primary windings and both ends of the transformer mounted current limiting fuses are automatically grounded to provide maximum operator protection. When the carriage is in the disconnect position, the fuses protrude past the rear switchgear wall making it unnecessary to reach inside the compartment for fuse removal and replacement.

The secondary control wiring between units can be inspected by merely removing a top plate which exposes the trough wiring. Routine inspection and maintenance can be accomplished by physically following a wire from one unit to another, thereby eliminating the need for "unbundling" control wiring.

The breaker has an opening speed of 15 fps during arcing. All devices that comprise its operating control circuit are on the breaker itself for ease in testing. Each stage of the breaker mounted switch unit is individually adjusted so that no tools are needed to disassemble.

Dual cylinder puffers connected to a common header supply air to the arcing zone in the opening cycle to help move the arc into the breaker's interrupting device during low current interrupting.

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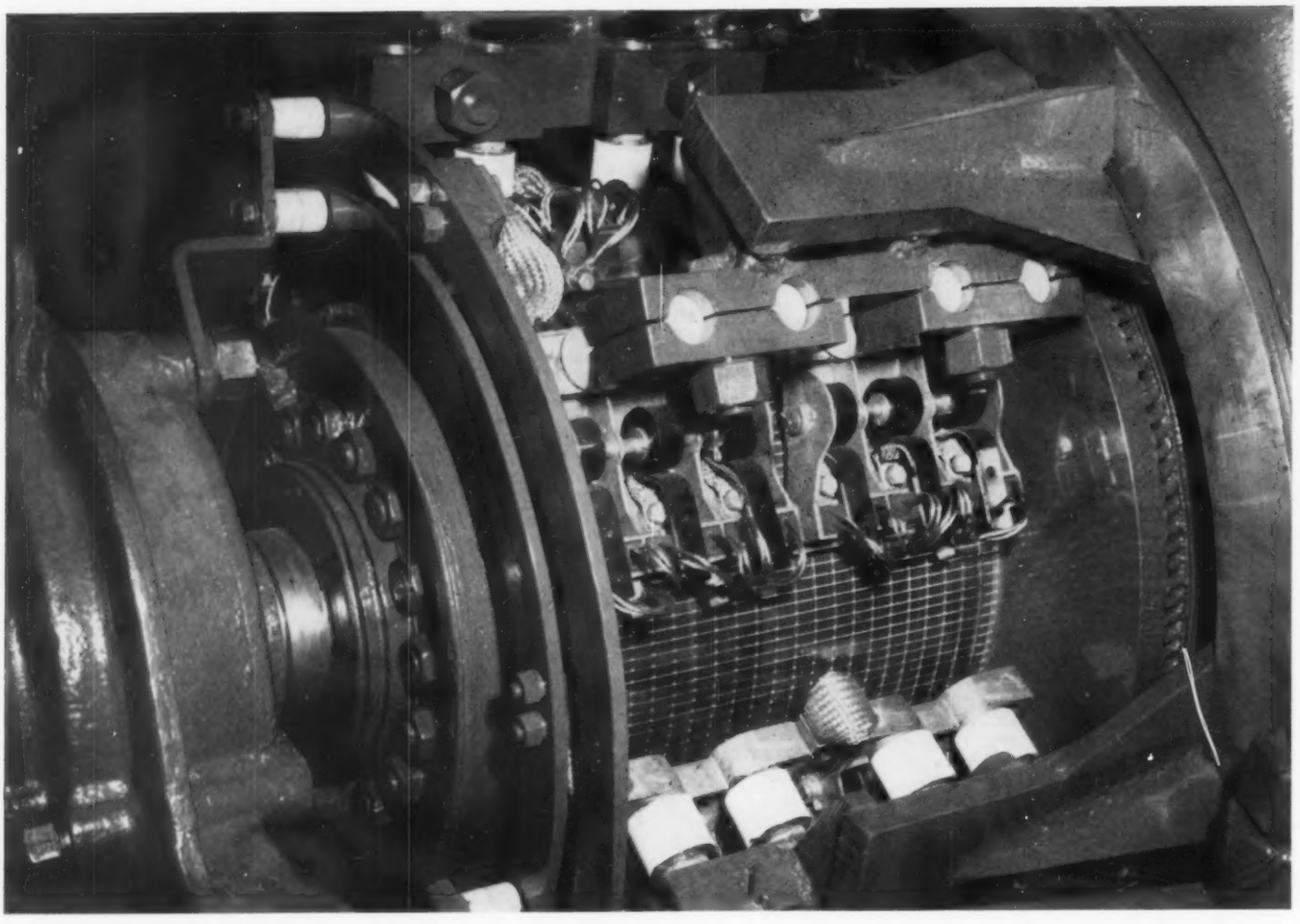

NATIONAL 'Improvement' Saved This Motor from the Scrap Heap

The motor shown above is one of three which powered bridge cranes on an ore unloading dock. After years of operation it was obvious that these motors had reached the point where complete rebuilding would be required to insure continued service.

The motor manufacturer considered the design obsolete and replacement parts were not available. But to replace the motors would have been extremely expensive. Not only would new motors have been required, but the existing crane structure would have had to be modified to accommodate them.

National undertook not merely to repair the motors but to redesign and modernize them. Work done included:

1. design and manufacture of new commutators
2. design and winding of new heavy duty fields
3. rewinding of the armatures
4. design and construction of more rugged brush holders and brush rigging.

As a result of National "repair and improvement", the motors were made more efficient in their performance and less costly to operate and maintain. The peak current demand of the redesigned units is on the order of 6000 amperes as compared to 8000 ampere peaks before rebuilding. And practically all of the parts now required for maintenance are standard stock items.

This case is typical of National repair service. Improvement, not merely repair, is always the objective. For details on how National redesign ingenuity can help *you* solve your tough electrical maintenance problems, just call your nearby National field engineer or drop us a line.

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Above is shown a Cleveland size 500 AH unit which operates the Kick-Off Drive for the cooling bed of a Birdsboro Merchant Mill at Phoenix Manufacturing Company—Steel Mill Division, Joliet, Ill.

CLEVELANDS drive these merchant mill cooling beds

FROM the merchant mills, white hot bar and rod stock shoots out on these cooling beds. And transmitting power smoothly and uniformly, to keep the beds rolling at mill speeds are the Cleveland Worm Gear Drives shown here.

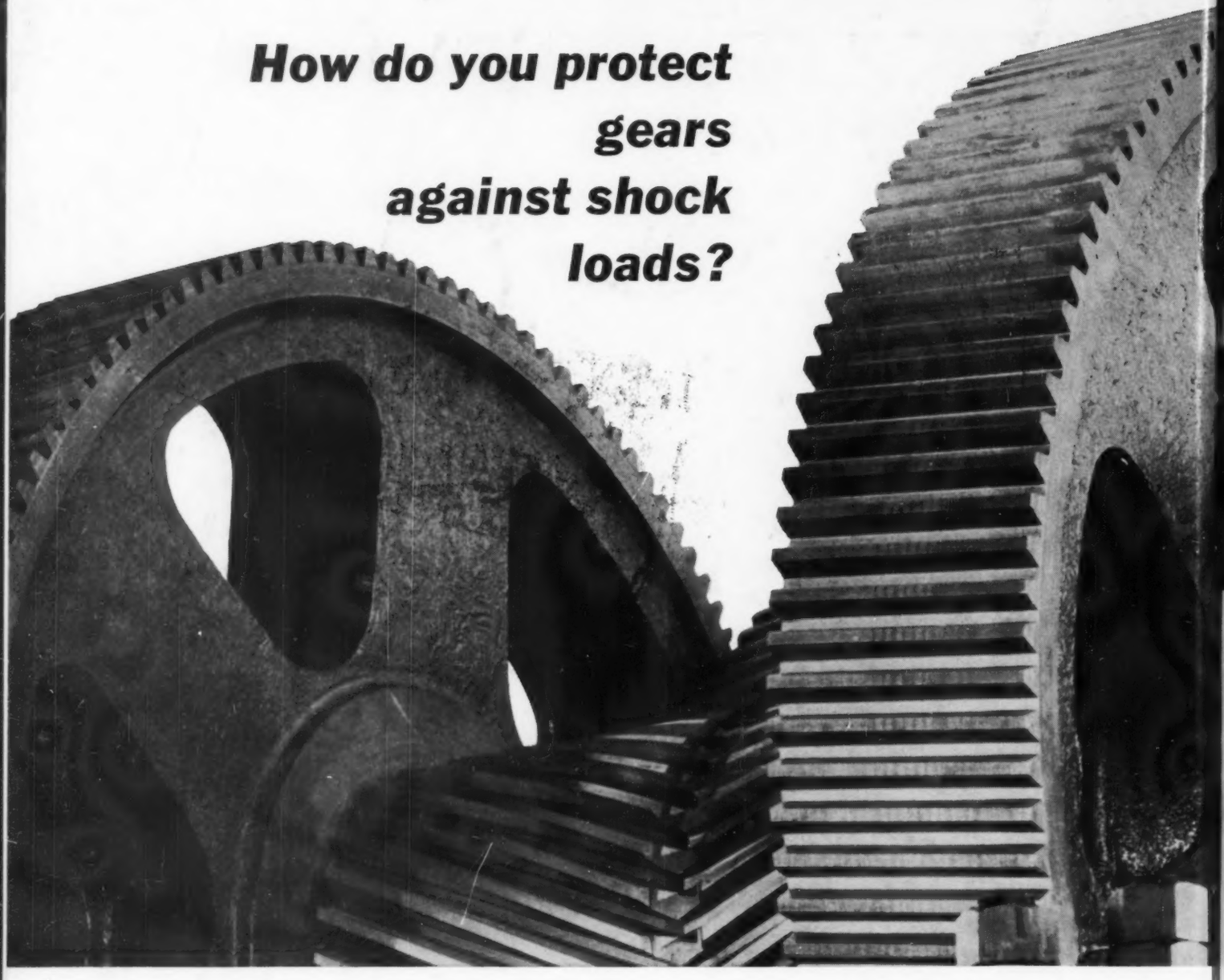
Wherever motor power must be transmitted through a right-angle drive, efficiently, uninterruptedly, regardless of load or shock, you can depend on a Cleveland. Hundreds of thousands of Cleveland drives are in continuous, heavy-duty service, many on the job for twenty, thirty, forty years and more.

There are Cleveland models to meet every requirement. Write for Bulletin 145, which illustrates and describes the many types and sizes of worm gear speed reducers in the Cleveland line. The Cleveland Worm & Gear Company, 3278 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

CLEVELAND
Worm Gear
Speed Reducers

How do you protect gears against shock loads?



The great pressures suddenly generated under shock loads can cause serious damage to costly gears unless adequate measures have been taken to prevent it. This is why the choice of the proper lubricant is so important —and why so many steel mills use Texaco Meropa.

Special polar additives in Texaco Meropa Lubricant adhere to metal surfaces with an extremely powerful bond. Even under tremendous shock pressures, a protective film of Meropa remains between gear teeth, effectively guarding the metal against scoring, spalling, ridging or scuffing.

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